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RESEARCH

THE KEY TO

AGRICULTURAL PROGRESS

65TH ANNUAL REPORT OF THE
UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MD. 1951-1952

This annual report is designed to provide the farmers, Extension workers, and other Maryland people interested in agriculture a brief resume of the research studies underway in the Agricultural Experiment Station.

It is increasingly accepted and evident that a prosperous agriculture depends upon an active and progressive research program bringing advances through new discoveries and directed toward solving important problems by the application of science. This is especially true where highly intensive and widely varied types of agriculture predominate as in Maryland.

Unfortunately, inflationary trends do not by-pass research programs. The constantly increasing costs of all types of scientific equipment and laboratory supplies, of animal feed, fertilizers, seed, machinery and labor are cutting heavily into the research dollar and hence into the total output of research programs. Every effort is being made to keep pace with the most pressing problems. Those remaining which are clearly recognized, and for which solutions would benefit both the farmer and the consumer are numerous. The agricultural scientist often sees the problems of tomorrow looming on the horizon, but resources limit the number which can be properly undertaken at one time. A review of this report will reveal, nevertheless, that the research accomplishments of the Station during the year have been substantial and gratifying.

The research program of the University of Maryland Agricultural Experiment Station has received support during the year from many public, private and industrial organizations and individuals. It is regretted that space does not permit recognition of all sources of help, but the cooperation of all is herewith gratefully acknowledged.

I. C. HAUT,
Director.

To the Governor of Maryland, the Board of Regents, and the President of the University of Maryland

I transmit herewith the Sixth-Fifth Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments conducted during the fiscal year ending June 30, 1952, and a statement of the receipts and disbursements for the same period.

I. C. Haut,

I.C. Haut

Director

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Agricultural Economics and Marketing

Research in agricultural economics and marketing delves into those phases of farm problems which relate to the economic and social aspects of the farming business and farm living. During 1951-52 agricultural economists conducted studies in farm management, poultry and dairy marketing, rural zoning, farm credit, rural fire protection, retail merchandising of farm products, fruit and vegetable canning and marketing, farm taxation and farm tenancy.

Production Economics

Studies Show Increased Interest In Rural Zoning in Maryland

Interest in rural zoning is spreading to typical rural counties in Maryand, where formerly it concerned the more urban counties adjacent to large metropolitan centers. The expansion of Maryland's heavily traveled highway system plays an important part in this increased interest.

Zoning ordinances are county-wide in three counties; they apply to portions of five counties; and two other counties are in the initial stages of adopting such measures. Nine of the remaining 13 counties are covered under the state-wide rural zoning option enabling act, and in several of these counties rural zoning proposals are being discussed and committees of investigation have been formed.

Important provisions of zoning ordinances from the viewpoint of agriculture are those creating districts or zones in which the use of land or buildings is designated. The major district classes are agricultural, residential, commercial and industrial. (*Project A-32-I*)

Research Uncovers Factors Affecting Dairy Farmers Profits

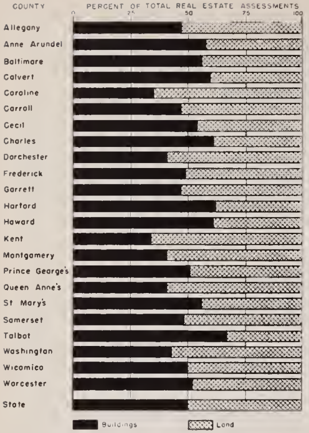
A study of 82 dairy farms in Maryland showed that several factors affect profits. The most profitable dairy farm group (20 farms) had an average farm labor income of $6,019. Labor income is the amount the farm operator receives for his labor and management after all expenses have been paid and interest allowed on the investment. The least profitable farms had a loss averaging $3,745 and therefore did not return interest on the investment and/or a return for the farmer's labor.

Indicative of the intensity of dairy farming in the area studied is the fact that milk sales accounted for 88 per cent of the total farm income on dairy farms in the Washington area, 80 per cent in the Baltimore area, and 73 per cent in the Philadelphia area.

Primary factors affecting profits were the number of cows, production per cow, market to which the milk was shipped, and efficiency in the use of labor and in crop production. (*Project A-18-af*)

Unit Value Methods of Assessing Farm Buildings

Emphasis is being put on unit value methods of assessing farm buildings, in contrast to the spot value or lump sum method used almost exclusively in the past.



Farm buildings accounted for a large part of the assessed valuation of Maryland farms. This graph is based on 1949-51 figures.

For most types of farm buildings several methods are being used at present. However, recently constructed buildings are more apt to be assessed on the basis of the cubic content, square foot area, or unit capacity.

Farm dwellings are the most important single building assessment unit on most farms. Since a large proportion of these dwellings are old, their appraisal for tax purposes becomes complex, if they are to be assessed comparable to urban dwellings.

The application of unit values in assessing farm buildings is limited largely because the value of such buildings depends on the reasons owners purchase farms and on how they use the buildings. Under such circumstances, judgment must play a large part in assessing buildings, after a unit value technique has been applied. (*Project A-19-i*)

Rural-Urban Fringes Create Property Tax Problems

Tax officials are searching for techniques and methods which will provide equitable taxation of farms in the rural-urban fringe areas. Two Maryland counties, Baltimore and Montgomery, were studied to determine the methods of approach to this problem.

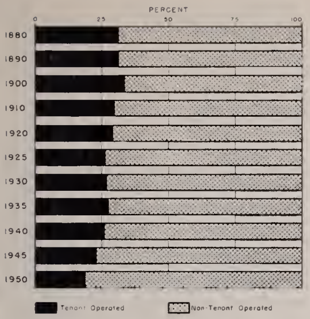
In Baltimore County farmsite acreage is assessed separately, and at percentages of the rates on nearby or urban lots. The remainder of the farm acreage is classified and assessed at rates which are fixed percentages of the farmsite rate.

In Montgomery County a combination of techniques is employed. Frontage and depth factors play an important part, especially in the upper part of the county. Sales price comparisons and unit value calculations on buildings are also determining factors.

The results of the systems in both counties are tax levies which are not necessarily related to the productive use value of farms. This situation might be corrected to some extent either by (1) coordination of assessment and zoning policies, or (2) distinguishing between farms and nonfarm acreage for tax assessment purposes. (*Project A-19-k*)

Farmers' Attitudes Toward Social Security Influenced by Their Financial Status

The financial status of farmers appeared to influence their attitude about social security more than any other single factor. Research by



The percentage of Maryland farms operated by tenants has declined steadily since 1880.

agricultural economists shows a concentration of farmers in the lower net worth groups. About one-fourth of the farmers had a net worth of less than $10,000 per farmer, and another one-fourth had a net worth of $10,000 to $20,000. Only 11 per cent had a net worth of $50,000 or more. The higher the net worth of farmers the lower the percentage favoring a social security program for farmers.

Some of the more important factors affecting farmer reactions to social security were the ratios: of: (1) farm assets to financial assets; (2) total assets to total liabilities; (3) total assets to mortgage debt; (4) net worth to total debt; and (5) farm land and buildings to mortgage debt. (*Project A-19-1*)

Decline in Farm Tenancy Continued in Maryland

There has been a long-time decline in the proportion of farms in Maryland operated by tenants. Prior to 1925 nearly one-third of all farms were tenant-operated. From 1925 to 1940, inclusive, the proportion of tenants stayed close to 26.5 per cent. Since 1940, the tenanted farms, both in number and percentagewise, have decreased rather rapidly, with 18.6 per cent tenant operated in 1950.

The Upper Eastern Shore is still the predominate tenanted area based on percentages. Southern Maryland is next, followed by the Lower Eastern Shore counties and Western Maryland counties, respectively. (*Project A-32-f*)

Marketing

Tests Show That Consumers Recognize High Quality Sweet Corn but Grocers Do Not

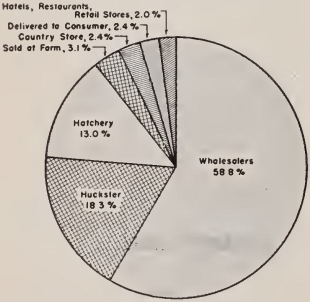
A taste panel clearly indicated that consumers are able to distinguish the higher sugar content of sweet corn which had been hydro-cooled immediately after harvest and kept at a temperature of less than 60 degrees during the entire period prior to cooking. However, a survey showed that most retail and wholesale handlers of sweet corn do not appreciate the necessity of holding this product at considerably less than room temperature during the entire time it remains in wholesale and retail trade channels.

It was evident that producers can and will cool newly harvested sweet corn and keep it cool until delivery to wholesale or retail outlets for a slight premium over the normal market price. Corn packed in crates during the marketing process may be held at lower temperatures more easily than that sold in burlap bags, mesh bags, or bushel baskets. (*Project A-26-q*)

Wide Broiler Houses Cost More and are Difficult To Ventilate, but Save in Labor Costs

According to a recent study the construction of wide broiler houses costs approximately one-third more per square foot of floor space than narrow houses. However, producers with this type of construction were able to save from one-third to one-half in the cost of labor per 1,000 birds started. Producers with narrow houses spent considerably more time in the routine chores of feeding birds and cleaning houses.

The problem of ventilation is more serious in wide houses, but mortality in wide houses was approximately one per cent less and heavier birds were being sold at a younger age. This situation prevailed in spite of the fact that feed efficiency appeared to be slightly better in narrow houses. It was evident from this survey that regardless of type of house design mortality can be reduced and feed efficiency improved by allowing more floor space per chick. Most growers were allowing from .6 to .8 square foot per bird started. (*Project A-18-ah*)



The selection of a good egg market is important in profitable egg production. Studies show that egg producers in Maryland sell direct to consumers, hatcheries, wholesalers, restaurants, hucksters and country stores. Egg markets are selected on the basis of price received by farmers, difference in cost of marketing, breed of layer, and value of production.

Peaches Bruised by Pickers Who are in a Hurry

A study of 84 peach pickers in Maryland orchards during the 1950 harvesting season demonstrated the fact that speed is closely associated with bruising in the picking operation. Pickers paid an hourly wage bruised slightly less than 2 per cent of their volume compared with over 5 per cent for those who were paid by the box. Bruising averaged 3.8 per cent when peaches were dropped into the picking containers compared with 2.4 per cent when they were placed in without dropping. Similarly, pickers who stood almost erect while emptying their containers of peaches into a field crate had an average bruising rate of 3.4 per cent compared with 2.6 per cent for those squatted on their heels while performing the same function. (*Project A-26-w*)

Many Consumers are Willing to Pay Extra for Prepackaged Spinach and Kale

A study of sales of prepackaged versus bulk spinach and kale in retail stores indicated that when both prepackaged and bulk are available at the same time some consumers will switch to bulk purchases, but a substantial amount of the bulk spinach sold represents a net increase in total sales. During the local harvesting season for fresh spinach the combined sales of the prepackaged and frozen product declined slightly but remained approximately 40 per cent for prepackaged and 13 per cent for frozen. This indicates that approximately half of the consumers were willing to pay for the extra service even though the price per edible pound of the prepackaged product was about twice that of bulk offerings.

Consumers demonstrated a slight preference for plain bags compared to printed bags when both were made available at the same time. However, it is doubtful that the saving of 1 cent per bag in cost to the manufacturer will be likely to compensate for the presumed advertising value of a printed bag. (*Project A-26-p*)

Improved Quality Index for Type 32 Tobacco Aids in Price Comparisions

A large and fluctuating volume of tobacco unsuited to cigarette manufacture, and subject to very wide price variations in recent years, has made it almost impossible to compare the average prices received by Maryland growers from one year to the next. As part of a continuing study of tobacco marketing a quality index was developed which gives a concrete indication of the quality of each tobacco crop and shows the extent to which average price changes from year to year were a result of changes in quality or changes in the price level. (*Project A-26-ag*)

Survey Indicates the Bulk of Maryland Canned Vegetables are Sold to Brokers in Nearby States

Information furnished by 27 canners on the distribution of their 1949 pack, disclosed the fact that 20 per cent of all Tri-State tomatoes, tomato juice, corn, peas, and snap beans moving out of Tri-State area went to Pennsylvania, 17 per cent to New York State, 8 per cent to Virginia, 6 per cent to the District of Columbia and 12 per cent remained in Maryland. Thus 60 per cent were sold in the nearby area, and no other state received as much as 5 per cent of the total.

Over 80 per cent of the Tri-State canned products sent to New York State was consigned to New York City. Philadelphia accounted for more than one-half of amount going to Pennsylvania, and Baltimore used more than four-fifths of the Maryland consumption. Richmond received a third of the total sales in Virginia. Although three-fifths of the total Tri-State pack were distributed in nearby areas the remaining 40 per cent was widespread over the nation. Boston, Mass.; Pittsburgh, Pa.; Los Angeles, Calif.; Cincinnati, Ohio; Chicago, Ill.; Newark, N. J.; and Jacksonville, Florida were important receivers.

Further analysis of 1949 sales by grade shows a marked quality difference between products canned in the Tri-State area. Over 99 per cent of the tomato juice graded U. S. Fancy, while less than 1 per cent of the canned tomatoes were in this grade. Slightly over 44 per cent of the corn was fancy grade, 28.7 per cent of the beans, and 15 per cent of the peas. Conversely 73 per cent of the tomatoes, almost half of the peas, and one-fourth of the beans graded standard or less.

Almost three-quarters of the 1949 pack of tomatoes, corn, peas, and snap beans was sold to brokers. The remaining fourth was sold by the canners directly to chain store organizations and wholesalers. (*Project A-26-ab*)

Early Maryland Potatoes at a Disadvantage Because of Rough Appearance

Maryland potatoes usually compete in this area for the early market with potatoes from California which frequently have a much better external appearance, but no internal advantage. When Maryland potatoes were handled with extreme care to minimize the outside blemishes, scratches and feathering due to customary handling practices, consumers did not discriminate against them in retail stores. There was some indication that consumers would pay a slight premium and increase their purchases of Maryland early potatoes if external blemishes and feathering were reduced to the absolute minimum. (*Project A-18-ac*)

Follow-The-Leader Price Reductions in Retail Stores Fail to Increase Sales Volume on Fresh Killed Poultry

As part of a continuing study on the marketing of poultry products an investigation was made of pricing policies in a small number of retail stores. Fryers were commonly used as a price leader in week-end reductions designed to increase volume. However the quantity sold was not significantly different when prices were reduced than on one or two occasions when no price reduction was made. Apparently retailers are assuming a greater demand elasticity for poultry meat than generally exists in the minds of consumers.

Although three-quarters of the weekly volume of sales occurred in the last three days of the week the same situation prevailed whether broiler prices were reduced or not. Furthermore, during the period studied retail prices for poultry meat, whether sold in the form of whole birds or cut-up, appeared to have little relationship to changes in either the farm or wholesale price. Retailers tend to vary their margin with changes in the wholesale cost, and only rather marked differences in the wholesale price will result in a change at retail. (*Project A-26-ac*)

Other projects conducted in the field of agricultural economics and marketing include: "Sales Taxes and Their Application to Farmers," "Organization and Operation of Representative Types of Farms in Maryland," "Agricultural Production Capacity and Efficiency," "Rural Cooperative Credit," "Economic and Security Aspects of Rural Fire Protection and Prevention in Maryland," "Conservation and Economy in Rural Transportation of Persons, Supplies and Farm Commodities," "Prices Paid by Farmers for Commodities Bought," and "Effect of Drainage Upon Crop Yields, Farming Practices and Land Utilization."

Agricultural Engineering

Slatted Floor System Proves Best for Mow Drying Baled Hay

Studies made throughout the State showed that all mow drying systems in use are satisfactory for either long or chopped hay, if the hay is placed properly on the system.

Static pressure and relative air movement through the hay are the main points checked when the hay is properly placed. The static pressure reduces uniformly as readings are taken in greater distances from the main duct. This condition indicates a good general distribution of air.

However, all systems were not equally effective for drying baled hay. The slatted floor with a closed main duct having controlled air openings at top of the duct and at floor level proved to be the most efficient. The "open center duct," an open framework or structure placed in the center of the drying area showed a very rapid drop in pressure as readings were taken at greater distances from the duct regardless of the care and skill of placing the baled hay. Less than .02 inch of static pressure was found in the outer layers. This was caused by escape of air between bales. In most cases, air movement was less than could be recorded on the instruments available.

This low volume of air cannot effectively dry the hay in the outer layers. The slight additional cost of the slatted floor arrangement which feeds the air to all parts of the drying area can easily be justified through lower operating costs and higher quality hay. Many other systems previously used for long and chopped hay are also inefficient because of the difficulty of placing bales.

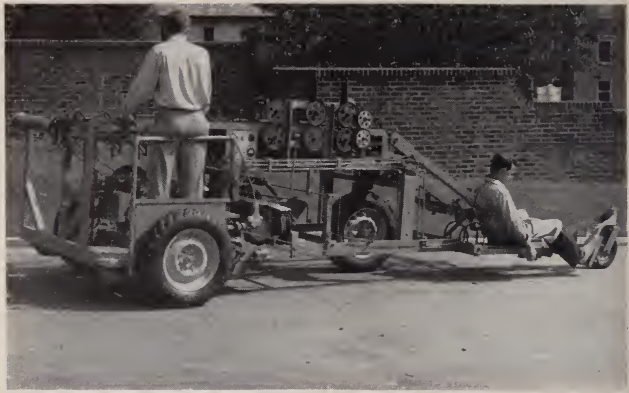
This large drier for baled hay is in use on a Frederick County farm. Its construction is based on findings from research studies.

Research will be continued next season to test the various types of heat systems available for use in hay drying in Maryland. (*Project R-14*)

Engineering Problems Related to Production, Harvesting, Curing and Storing of Maryland Tobacco are Investigated

Further tests were made on a tobacco spearing machine, and minor mechanical shortcomings encountered during the past season were corrected. The machine has been rebuilt as a two-man self-propelled unit to be used in the field and is ready for field test during the harvest season of 1952.

The use of supplemental heat and forced air to control curing during high humidity weather was tested for the third season. Much better condi-



The tobacco spearing machine has been redesigned as a self-propelled unit, and is now ready for field tests.

tions were maintained during this past season than previously. A 150,000 BTU/hr. oil heater was used and the air from the barn was recirculated through the heater, making for a more efficient use of the heat. A temperature rise from 20°F. to 25°F. was maintained in the barn while using the heater, resulting in a very good cure. Grading of the crop has not been done to date.

Tobacco grown in 1950 and cured in the experimental barn sold for an average of 10.10 cents per pound above the state-wide average.

Continued research on fluorescent lighting for stripping indicates that a combination of one daylight tube and one 4,500° white deluxe tube or cool white deluxe tube is best. The deluxe white tubes have a red color factor and are better than the standard 4,500° white tube previously recommended. (*Project R-11*)

New tobacco curing barn built in 1951-52 for research studies at the Tobacco Experimental Farm (left). Right, interior view of the new barn, showing duct for mechanical ventilation.

Ear Corn can be Dried Successfully with Unheated Air

Research on drying ear corn with unheated air was continued during the past year. The tests were conducted on corn stored 10 feet deep in bins. A crib of the same size as the bins, representing a short section of a longer crib was used to represent usual storage practices.

Air rates of 2.5, 5, and 7.5 cubic feet of air per minute (C.F.M.) per cubic foot of bin space were tested. The blower operation was controlled to operate only when the relative humidity was below 75 per cent during the first 25 days. After that time it was set to operate at 60 per cent or lower. Some mold again developed at the lowest air volume, while drying at the higher air volumes showed no mold whatsoever.

A pair of bins was used to compare continuous blower operation with operation at low humidity only. The corn in both bins was in excellent condition with no sign of mold. Continuous operation showed a slight advantage during the first two weeks after which the intermittent operation showed a slight advantage. Cost of intermittent operation would be less than half that for continuous operation. Each of these bins dried more than 70 per cent faster than the crib. Corn in the crib was badly molded from top to bottom in the center section.

A bin with considerable loose grain husks dried as fast as those with clean corn. This no doubt would not be true if the husks and loose grain were unevenly distributed as it might be under a elevator. (*Project R-12*)

Entire bins of corn are weighed during tests to determine the rate of drying under various methods.

Field Test of Homemade Walk-in Refrigerator

Two farm type walk-in refrigerators with chill room and 0°F. storage room were built in Charles and Frederick Counties. This was a cooperative project between the farmers involved, the U. S. Department of Agriculture and the Agricultural Engineering Department of the University of Maryland. Field tests of the design, developed by the Bureau of Human Nutrition and Home Economics, are being conducted jointly.

These walk-in refrigerators have a room for chilling and storing meat and other farm products (approximately 250 cubic feet) and a low-temperature room for freezing and storing fruits, vegetables, and meats (approximately 100 cubic feet). The farmers did most of the construction work following USDA plans. Recording instruments have been installed and operating and use records are being kept.

Aging beef in the chill room of a newly devised homemade walk-in refrigerator.

The chill room will cool one beef carcass or one large hog or 600 pounds of other produce at one time. The freezer room will freeze 100 pounds per day. The electric consumption is estimated at approximately 200 kilowatt hours per month on a twelve months basis. The cost of materials for the refrigerator was about $1,100. (*Project R-17*)

Spraying Machine Developed for Control of European Corn Borer in Sweet Corn

Two spraying machines, one a front wheel drive and one a rear wheel drive were tested last year. Having had excellent results with the rear wheel drive machine, the use of the front wheel drive sprayer was discontinued. Tests were made this year on the rolling fields of Frederick and Montgomery Counties so that the stability of the machine could be determined.

There was no slippage or tendency to tip at any time during tests. Although spraying was done across 30 per cent slopes.

The use of this machine need not be limited to sweet corn. When used to spray peas, for instance, the only change needed was a different boom design to effectively place the spray material where desired.

One serious problem encountered in earlier tests was the large amount of time required to refill the spray tank on the machine. In previous seasons this required from 15-20 minutes for each 110 gallon tank. This limited the acreage daily. This was serious because of the rather large acreage to be covered and the limited time during which effective spraying could be done.

The newly developed rear wheel drive spraying machine is adaptable to all types of terrain in use for growing sweet corn in Maryland. This machine may be used to spray peas or any other crops.

This problem was solved by the development of a "mother" or "nurse" tank mounted on a separate truck. Six hundred gallons of material can be mixed in this tank at a time. The spray material is stirred continuously with a built-in agitator, and the tank has a pump for faster refilling of the tank on the sprayer.

The sprayer tank has been increased in capacity from 110 gallons to 150 gallons. The refilling time was reduced from 15 minutes for 110 gallons of spray to 3 minutes for 150 gallons.

Workers using this equipment feel that the separate large supply tank is as important as the sprayer itself in having the proper equipment to effectively apply insecticides to the sweet corn crop. (*Project R-13*)

The use of the tank truck cuts the time consumed in refilling the spray tanks to less than one-fifth of what it was before.

Agronomy

Research agronomists are continuing their search for ways to make the production of field crops in Maryland better and more profitable. This search leads to many studies, some of which have immediate application to the farming operations in Maryland, and others which must first lay the background for the later studies having practical value.

To accomplish the improvement of crop production, the Agronomy research staff is working closely with researchers in several other departments in the Experiment Station's integrated program for better agriculture in Maryland. Close contacts are also kept with research workers in other states of this region so that advancements can be made most rapidly and economically.

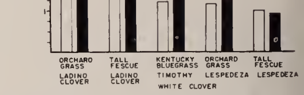
Pasture and Hay Crops

Pasture Mixtures for Beef Production Studied

An important phase of the search for pasture and forage crops that will better meet the needs of Maryland livestock, is the study to determine the pounds of beef that can be produced from an acre of land in pasture.

The present study was begun following the establishment of mixtures in the late summer of 1949. Five pasture mixtures; (1) orchard grass and Ladino clover, (2) tall fescue and Ladino clover, (3) Kentucky bluegrass, white clover and timothy, (4) orchard grass and lespedeza, and (5) tall fescue and lespedeza were established on land which had been relatively unproductive at the University of Maryland Tobacco Experimental Farm near Upper Marlboro.

The forage production of the five pasture mixtures is being studied at fertility levels of 400 and 700 pounds of 0-12-12 per acre each year.



Orchard grass-ladino clover and tall fescue-ladino clover were highest yielding of 5 pasture mixtures tested. The higher yielding mixtures also showed greatest response to increased fertility levels.

Yearling Hereford steers are pastured in a rotational grazing system. Each steer group remains on a single mixture during the entire season. Weekly weight gains are recorded as the animals are moved from one paddock to another. The steers have free access to salt, minerals, and water.

The tall fescue-Ladino clover and the orchard grass-Ladino clover mixtures produced the most dry matter and beef per acre, with the combination Kentucky bluegrass, timothy, and white clover in intermediate position and with orchard grass-lespedeza and tall fescue-lespedeza as the least productive mixtures.

The results indicate that the response to the higher fertility level was greatest in the most productive three mixtures. (*Project B-56-j*)

Pasture Renovation Studies Show Improved Methods

Farmers of the State are continuing to ask about the best ways to renovate pastures. These questions are concerned with renovation of Kentucky bluegrass and white clover sods to establish taller growing pasture mixtures and with renovation of orchard grass stands to re-establish tall growing legumes. To provide this information pasture renovation tests were begun in the spring of 1947 and will be completed during the summer of 1952. The variables under study are fall versus spring establishment, disking versus shallow plowing, and the study of a number of grass and legume mixtures for use with these times and methods of land preparation.

In general the 1951 results show that orchard grass and tall fescue in combination with Ladino clover, red clover, and alfalfa produced the most dry matter per acre. Tall meadow oat grass and Ladino clover was also a high yielding mixture. As has been

Yearling Hereford steers are pastured in a rotational grazing system to test the productivity of various pasture mixtures in Southern Maryland. This method allows a recovery period of three to four weeks for each pasture before it is again grazed.

found in past years the addition of red clover and alfalfa to the orchard grass and Ladino clover mixture considerably increased the yield of forage. The differences between the better and poorer mixtures were not as great during 1951 as in past years. This seemed to be largely due to the dry season which reduced the production of all of the mixtures under study.

Plowing in the spring and disking in the fall as means of seedbed preparation were the superior treatments from the standpoint of dry matter yields.

The findings of this study have been summarized and now form the basis for Extension recommendations in Maryland. They have been widely circularized in mimeographed form and will serve to bring this information to farmers of the state until such time as the study is completed and a complete summary is made. (*Project B-56-b*)

Extensive Variety and Strain Tests Continued

Maryland agronomists are continuing extensive forage variety and strain tests in cooperation with Experiment Station workers of other Northeastern states. These tests are proving valuable in recommendations of varieties for use in Maryland and in bringing these recommendations into agreement with those of adjoining states insofar as soil and climatic conditions make this logical.

The yields of alfalfa varieties remained at a high level in the second year of harvest. Narragansett, Williamsburg, and Atlantic were superior. Among the smooth bromegrass varieties tested, those of Southern origin continued to be more productive than Northern types. Most varieties of timothy gave good spring growth, but produced very little in later harvests.

Beltsville orchard grass continued to show superiority in leafiness and freedom from leaf diseases and insect damage. This variety proved more

Newly developed techniques in pasture renovation received first-hand study by farmers visiting the Plant Research Farm.

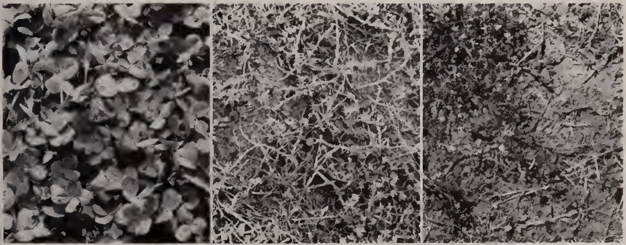
A group of Maryland farmers are told of recent research in agronomy at a field day. (forage crops).

usuable in mixture with legumes because it had less tendency to reduce the legume stand by competition; however, commercial strains were slightly superior to Beltsville in total yield. Early Synthetic, an experimental strain of orchard grass from the Northeastern Pasture Research Laboratory, proved promising in the test.

The results of this year with birdsfoot trefoil, as in the past, show that it is inferior to most other legumes grown in Maryland for forage production.

Ladino clover stands were badly depleted during the late summer of 1951 through the spring of 1952. Important factors in this loss appeared to be the occurrence of Sclerotinia root and crown rot, winter injury due to heaving, and a weakening of the plants due to dry conditions in the fall of 1951. Several experimental strains of Ladino clover were superior in recovery from adverse conditions and in production of forage. (*Project B-56-f*)

Instrument developed to measure the amount of root heaving caused by freezing and thawing.



Stand of ladino clover in May, 1951 (left). In January, frost heaving has exposed many of the roots (center) causing the greatly reduced stand shown at the right.

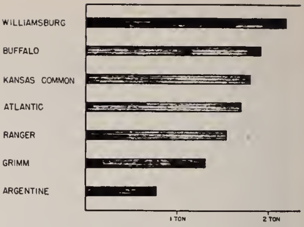
Better Understanding of Effect of Climate on Plant Growth being Obtained

Agronomists have been studying the micro-climate which surrounds forage crops growing at the Plant Research Farm. This study is planned to bring a better understanding of the reasons why certain forage plants are better adapted than others in terms of growth, resistance to disease and insects, and general plant behavior.

A direct relationship appears to exist between early spring growth of forage crops and heat accumulation indices calculated from weekly frequency distributions of temperature. During the winter months of 1951-52 it was possible to evaluate some of the factors that contribute to loss of Ladino clover stands since continuous records of soil and air temperature, soil moisture, rainfall, and other climatic data were kept and were studied with plant response prior to and during the time the stand losses occurred.

Indications from this study are that if adequate soil moisture had been present during the latter part of the 1951 growing season, much of this loss could have been eliminated. In areas with more favorable moisture supply and with a better fall growth, the Ladino clover survived better. The study shows that frequent freezing, thawing, and comparatively shallow frost penetration is conducive to winter heaving. When these cold periods are followed by a week or more of warm temperature, conditions are ideal for growth of crown rot diseases. However, when these cold periods are followed by cold and windy weather, the newly exposed stolons and roots are dried out and frequently injured beyond recovery.

The micro-climate data collected and the observations during the past winter season indicate that plants were lost from all of these conditions at one time or another during the winter period. (*Project B-56-k*)



While the relative productivity of alfalfa varieties varies according to location, Williamsburg proved superior at all locations in tests made during the past year. The graph shows the average performance of each variety during the third harvest year.

State-Wide Tests Show Williamsburg Alfalfa Superior

Nine important alfalfa varieties have been tested during the past three years at four locations in Maryland to give a basis for alfalfa variety recommendations in the state. These tests were at the Plant Research Farm in Montgomery County, District View Farm in Washington County, Allan Lane Farm in Queen Annes County, and the Charles Rutledge Farm in Harford County.

Williamsburg variety was developed in Virginia and is of much interest to alfalfa growers in Maryland. One problem in the use of this variety is the limited quantities of seed that will be available during 1952 and 1953. If adequate supplies of seed are available in later years, this variety should make an important contribution to Maryland agriculture.

Buffalo and Atlantic varieties have been dependable both in the variety tests and farmers' fields. Seed is available of these varieties and their use is increasing. The Narrangansett variety has been included in later tests and is very promising in the first and second harvest years. (*Project-56-d*)

Red Clover Variety and Strain Tests Continued

Previous tests have shown that Kenland red clover is superior as a variety for use in most of the state. With this information available for farmers, there has been a rapid increase in the acreage of Kenland seeded in the state.

During the past year red clover variety testing has studied the differences that may exist in certified Kenland red clover from various areas of production in the West. In the 1951 harvest no important differences were found among lots from Ohio, Montana, California, Washington, Kentucky, and Arizona. This indicates that the certification procedures are operating to give Maryland farmers a uniform, high quality seed of this variety regardless of location of production.

In tests during 1951 several strains of red clover which have been maintained for many years in Maryland were compared to Kenland. Many of these strains have yielded as well as Kenland and in the Eastern Shore area, several have been outstanding. These have been included in the red clover breeding program. (*Project B-56-e*)

Breeding for Improvement of Red Clover Continues

Agronomists in cooperation with plant pathologists are using the best Maryland strains and leading varieties from other areas as a source of material to develop better resistance to Southern anthracnose. The more productive plants are being selected from nurseries maintained on the Plant Research Farm and are being increased for testing. These tests will show what they offer in terms of better hay production on Maryland farms. (*Project B-56-a*)

Breeding to Improve Ladino Clover

Ladino clover has become a leading pasture legume for Maryland farmers. At present farmers buying seed are restricted largely to unnamed strains from the western part of the United States. Certified seed of Ladino has given acceptable performance and has been much superior to common Ladino seed on the market. However, most of the Ladino which has been available is quite susceptible to disease and stands may be severely damaged by drought or winter injury.

Initial trials have shown that some experimental varieties are superior to most commercial seed lots. A breeding program is under way to bring these desirable qualities into a variety which can be used in Maryland. Superior plants selected at the Regional Pasture Laboratory, State College, Pennsylvania and at the Agricultural Research Center, Beltsville, Maryland are being used in this development program. (*Project B-56-g*)

Improved Orchard Grass Strains Being Developed

The use of orchard grass in semipermanent pasture mixtures throughout Maryland is continuing to increase. Some orchard grass has been used in hay mixtures with alfalfa. In both instances the early maturity and disease susceptibility of commercial strains has been a limiting factor to production. In the breeding program a number of plants have been isolated which mature late, are resistant to important leaf diseases, and are superior in leafiness. These are being tested for performance. Superior plants will be combined into experimental synthetic varieties and will be tested at various locations in Maryland. This work will lead to better types for Maryland than those which have been available.

Soils

Fertilizer Increases Yield of White Potatoes

Studies were conducted to determine the optimum fertilizer practices in the growing of white potatoes in Garrett County. Results of the previous year showed that the plots which were sprayed for disease control and which had 88 pounds of actual nitrogen applied with the spray yielded 270 bushels per acre, while the heavier applications of fertilizer resulted in yields of more than 500 bushels per acre.

The 1951 growing season was somewhat drier than was experienced in 1950; however, large differences were found in the yield of potatoes as affected by rate of fertilizer application. Table 1 gives the important results concerning the past year's research.

It is interesting to note that although the lowest yield was obtained where nitrogen in the spray was the only fertilizer material applied, this yield of 256 bushels was 102 bushels above the county average. It is also interesting that in the 1951 season for a period of about two months during the growth of potatoes, the rainfall was only one-half the normal amount received, yet during this dry season the high rates of fertilizer used returned a worthwhile profit.

These potatoes are being grown in a 3-year rotation with oats and red clover. (*Project 0-28-b*)

Alfalfa Needs for Phosphorus and Potash Studied on Different Soils

The importance of proper rates and ratios of phosphorus and potash applications to alfalfa on various soils in the state was studied at two locations during 1951. These plots were located

TABLE 1—Effect of Various Rates of Fertilizer Application on the Yield of White Potatoes

Row Application 600 Lbs/A	Broadcast Application Lbs/A		Supplemental Nitrogen Lbs/A Side dressed	N in Spray Lbs/A	Yield in Bu/A 1951
				88	256
3–12–12				88	345
3–12–12	1000 Lb.	0–0–20		88	325
3–12–12	1000 Lb.	0–6–0		88	332
3–12–12	1000 Lb.	0–6–20		88	401
3–12–12			150	88	362
3–12–12	1000 Lb.	0–6–20	150	88	416
2–12–12	1000 Lb.	0–6–20	250	88	412
3–12–12	2000 Lb.	0–6–20	250	88	420
3–12–12	2000 Lb.	0–6–20	150	88	393
			L.S.D. at 5%		64

near Easton in Talbot County and near Poolesville in Montgomery County. Rates of 20 per cent superphosphate varied from 0 to 2,000 pounds per acre and potassium chloride was varied from 0 to 1,000 pounds per acre.

On Sassafras loam soil, which had good previous fertilization in Talbot County, no important yield differences were found in the first year after alfalfa was established. However, at Poolesville on a Penn loam with less previous fertilization, yields varied from 1.99 tons of poor quality hay, where no phosphorus or potash was added, to 4.30 tons of high quality hay, where 1,000 pounds of muriate of potash and 2,000 pounds of superphosphate were added. During a 4-year period the most practical level of fertilization with phosphorus and potash will be determined and is expected to be somewhere between these two extremes.

Plant analyses and soil analyses are being made to study carefully the ways in which the phosphorus and potash applied to the soil is taken up by the plant and the effect of these materials on yield. In all cases adequate amounts of lime and boron have been available for the growth of the alfalfa plant. (*Project 0-51*)

Conditions Influencing the Availability of Applied Phosphorus and Potassium Studied

In the laboratory, Maryland soil scientists studied the reaction of applied phosphorus and applied potash with reference to their availability. Frequently, a greater proportion of phosphorus was available when it was applied as a mono-calcium phosphate alone to soils than when applied as a mono-calcium phosphate with potassium chloride Phosphorus fixation was increased to a maximum in six out of nine different soils studied when the exchangeable potassium in the soil was first increased.

The availability of the applied phosphorus was increased when the exchangeable calcium of the soil was increased. This was due in part to the increased retention of the applied phosphorus following leaching.

These laboratory studies indicate need for further field experiments to examine phosphorus-potassium relationships. (*Project 0-45-b*)

Effects of Cropping Systems on Soil Properties and Productivity Studied

The crop rotation used on an area of land has an important effect on the productivity which that soil maintains, and on its value for future production. Early studies at the Maryland Agricultural Experiment Station have shown that short rotations can produce a high return per acre of feed for livestock. An example is the 2-year rotation in which corn the first year is followed by wheat and lespedeza in the second year. With this rotation two grain crops and a hay crop are made during the 2-year period. These short rotations appear to be valuable on some Coastal Plain soils where structure is not likely to limit production. This work is being summarized for farmers in the state.

Maryland soil scientists have begun a new series of field experiments in which various rotations are compared. An interesting phase of this study includes the use of a soil conditioner (Krilium) to determine its effect on the physical condition of the soil on a part of each plot included in the study. It is hoped that this will give valuable information as to the importance of physical condition of the soil in the production from various crops. (*Project B-61*)

Vegetation Affects Soil Moisture

Previous soil moisture studies conducted for a number of years at the Plant Research Farm indicated that the higher the plant growth over an area of soil the higher the soil moisture was likely to be during the summer growing period. In these studies pasture soils were found to be considerably drier than soils under hay, corn, and grass seedings, while soils under forest vegetation were the highest in moisture content of those studied.

During the past two years an experiment has been under way to study the soil moisture in randomized areas which varied in cover from bare soil to a heavy growth of Reed Canary Grass which reached four to five feet in height. At three to six inch depths in a Beltsville silt loam soil, the highest moisture levels were found where the soil was kept bare by cultivation, and the lowest where the tall cover of Reed Canary Grass was grown. As the height of vegetation increased the percentage of moisture in the soil decreased. The Beltsville silt loam soil maintained a higher moisture content where the surface was kept bare by cultivation than similar areas which were kept weeded and in a fallow condition but without cultivation. On this soil the increase in moisture with cultivation may well be due to increased infiltration rather than reduced evaporation.

The results of these two experiments tend to be contradictory. The moisture level maintained in a particular soil appears to depend on the extent to which the plants use moisture, the amount of the evaporation that occurs from the surface of the area, and the amount of rainfall that is absorbed by the soil. In the previous study it appeared possible that taller vegetation reduced evaporation sufficiently to maintain a higher moisture level in the soil. In the recent studies where these factors were compared side by side in equal plots, it is felt that it may not be possible to study this evaporation effect because of the size of the plots and the closeness of one condition to another. This indicates the need for additional work to study these factors as they operate on the soils in Maryland. (*Project 0-50*)

Grain Crops

New Field Corn Hybrids Tested Extensively

New field corn hybrids are available for testing each year in Maryland. In order that farmers of the state may have information that will let them use the hybrids that are best adapted to their farms, tests are conducted in various regions of the State each year. During the past growing season seven regional plots comparing double cross hybrids were planted in Maryland. The more promising new hybrids were compared to those which have well established records and which are recommended for farm use. Extremely dry conditions were found at some locations and heavy stalk breakage was found at one location. These conditions provided valuable observations concerning the performance of the individual hybrids. Out of these tests have come new hybrids which show considerable promise for use in Maryland. These newcomers to the recommended list are Conn. 870, Conn. 845, and Pa. 602. Complete results of these tests were summarized and distributed to corn growers in the state.

In addition to the work with hybrids that are ready for farm use, important breeding work is under way at the Plant Research Farm near College Park in cooperation with corn breeders in other Northeastern states. Ten inbred lines were planted to make all possible single crosses in order to evaluate parent inbreds that may be valuable for future use. Also, a test of experimental double cross hybrids was conducted to select those which will be useful in regional trials in coming years. (*Project B-50*)

Additional Sweet Corn Hybrids Tested

Sixty sweet corn hybrids were tested on the Plant Research Farm near College Park. Due to the severe drought which existed during the growing season, yields of these hybrids were low and results were confined primarily to observation. Valuable information was gained on resistance of these hybrids to drought. Those showing outstanding drought resistance were Narrow Grain 14x11, Peoria, Finegreen Country Gentleman, Silvergent, East Coast, Illinois 20, Illinois 21, Aristogold Bantam Evergreen, and Tendermost G. These results and data concerning average plant height, plant vigor, wilt injury, and productivity were prepared in mimeographed form and distributed to farmers.

Thirteen experimental single crosses from the work of the other Northeastern breeders were planted and evaluated. The more promising of these will be included in the regular testing program next year. (*Project B-44*)

Yields of Small Grain Varieties being Studied

BARLEY: Among eight varieties of winter barley compared in drilled plots, the varieties Wong, Jackson, Calhoun 3, and Davidson were most productive and showed little difference among them. Wong, however, had the best record for resistance to lodging. Lee winter oats, included in the barley variety test, proved to be less productive than the better barley varieties. Twenty-two entries of important new experimental varieties were included in a nursery with data secured for winter hardiness and yield. The more promising of these varieties will be included in regional tests in coming years. (*Project B-41*)

WHEAT: Twenty-five varieties were tested in drill plots at the Plant Research Farm. Seven varieties were compared on several farms in the Eastern and Central part of Maryland. The new leaf rust resistant selection, which at present bears the USDA number 2381, continued to yield with the best varieties, although leaf rust was not a limiting factor this season. With some of the varieties showing as much as 25 per cent lodging, selection 2381 lodged about 5 per cent and compared favorably with the stiff-strawed variety Thorne. Selection 2381 is being multiplied and if its good performance continues in 1952, it will be named and released as a new variety for use in the State. (*Project B-39*)

Tobacco

Methyl Bromide Continues as an Effective Soil Fumigant

The use of methyl bromide as a soil fumigant has continued to prove effective. There is some evidence that the gas tends to break the dormancy of hard seeds of white clover, which leads to the appearance of these clover seedlings in tobacco bed areas.

In addition to control of weeds, methyl bromide, when used at slightly higher dosages than 1 pound per 100 square yards, has proven helpful in controlling black root rot, and other soil-borne diseases which cause damping-off of tobacco plants. (*Project B-59*)

Other Tobacco Bed Treatments under Study

Cyanamid treatments produced a good supply of plants during the 1951 season. This season had adequate spring rains, and control with cyanamid was satisfactory. When cyanamid was used with urea in several proportions, the treatments proved less effective for soil fumigation as the proportion of urea was increased. Treatments which proved ineffective were chlorpicrin, allyl alcohol, sodium azide, and acetic acid alone or with Uramon. (*Project B-59*)

Tobacco Yield and Quality Affected by Fertilizer and Plant Population

During the 1951 growing season workers at the Tobacco Experimental Farm began an experiment to study the interrelationship of tobacco fertilizer rates and plant population on tobacco yield and quality. Results of the first year of the test were largely affected by mid-summer drought and later rains. Fertilization at 750 pounds per acre of 4-8-12 produced 1,125 pounds of tobacco with 26 per cent dull grades. Increasing the fertilizer to 1,500 and 2,000 pounds per acre increased yield to 1,237 and 1,316 pounds respectively, but increased dull grades to 31 and 36 per cent. Broadcast application was favored by 157 pounds per acre over banding, and 200 pounds over application directly in the row.

An increase in number of plants from 5,000 to 7,500 per acre resulted in a gain in yield of 121 pounds; a further increase to 10,000 plants, a gain of 141 pounds in yield.

It is expected that these increases due to higher rates of fertilizer and higher rates of plant population may be greater in favorable growing seasons. So these studies will be carried further. (*Project B-60*)

Quality of Maryland Tobacco Varieties Studied

In cooperation with the Maryland Tobacco Improvement Foundation, Inc., six commercially acceptable Maryland tobacco varieties and two mosaic resistant varieties were tested for differences in quality and yield. Some of the so-called leading Maryland varieties differed as much as 20 per cent in yield per acre. The difference in quality was almost as striking with the higher yielding varieties tending to be higher in quality as well. This type of test is to be continued and at the end of several growing seasons should furnish a reliable index to varieties for use under various conditions in Southern Maryland. (*Project B-64*)

Weed Control

Calcium Cyanamid Proves Promising in Control of Weeds in Field Corn

Tests were completed at three locations to compare methods of use of 2, 4-D and calcium cyanamid with cultivation to control weeds in field corn. Twelve combinations of treatments were made in three replications at each location. Yields of marketable corn were taken at each location and the number and kind of weeds competing with the corn crop was determined. The 400 pound rate of cyanamid for pre-emergence in combination with three cultivations proved to be an economical by sound treatment at all locations. Pre-emergence 2, 4-D at 1 pound per acre with two cultivations gave good results both in yield of corn and in value returned for treatment. With all pre-emergence treatments studied, some cultivation was necessary for top corn yields.

On the basis of the tests made during 1951, calcium cyanamid appears to be an excellent chemical for pre-emergence treatment of weeds on soils where the additional nitrogen applied is needed by the field corn. Complete details concerning the cost of each of the treatments studied and the value returned under 1951 price conditions are available in mimeographed form and were published in the proceedings of the Northeastern Weed Control Conference. (*Project B-58-a*)

More Effective Control of Chickweed in Fall Seeded Alfalfa

The results of a study conducted in Baltimore County during the winter of 1951-52 show that treatments with 1 pound per acre of acid equivalent of DNOSBP (4,6-dinitro-ortho-sec-butylphenol) gave reasonably good control of chickweed and caused no injury to the alfalfa. At 1951 retail prices the cost of materials for this treatment would vary from $3 to $4 per acre. The best time of treatment appeared to be during late fall or early winter. Heavier rates of DNOSBP, up to 4 pounds per acre, gave even better control, but did not appear practical in terms of the cost for the treatment.

In the work this year 3-chloro IPC has proved to be very effective in controlling chickweed, particularly when applied in mid-winter or early spring. In actual killing of chickweed, the 3-chloro IPC appeared more promising than any other chemical that has been tried to date. However, this chemical severely reduced alfalfa stands when used in the fall before plants became dormant. Also, 3-chloro IPC caused considerable shortening of growth if used after the alfalfa began growing in the spring. An important limitation to the use of 3-chloro IPC is the fact that it will kill any grasses which are being grown in association with the alfalfa. This will tend to limit its use to farms where alfalfa is desired in pure stands. 3-chloro IPC has not yet been produced in large quantities. If its use proves worthwhile for a number of herbicidal purposes it appears that the cost will be low enough for practical use.

If subsequent trials give the same general results as those of the past year, it appears that the chickweed problem may be considerably lessened in the alfalfa fields in Maryland through the use of one or both of these chemicals. (*Project B-58-b*)

Seed Inspection

During the past year 694 persons, firms, or agencies submitted 3,274 samples of seed to the laboratory for analysis. On these samples the laboratory made 1,402 purity analyses, 698 noxious weed examinations, and 3,193 germination tests.

These samples were divided among various legumes, vegetables, cereals, tobacco, forage grasses, and field corn.

In addition to analyses of seed lots, approximately 450 pounds of tobacco seed were cleaned for tobacco growers. This seed was received in small lots from individual growers, and served as an important source of clean seed for their use. (*Project X-9*)

Animal Husbandry

The primary objective of research workers in animal husbandry is to find new ways to increase net profits to the farmer as well as to furnish the consumer with a more desirable product.

Since fundamental advances in the industry are made through the development of new techniques and better sources of seed stock, most of the research is designed to find, if possible, new ways to evaluate beef breeding stock, safer methods to cure country-type hams, and to develop further and evaluate the meat-type Maryland No. 1 breed of swine. Production problems such as bloat in beef cattle are studied in the research program.

Animal husbandry researchers cooperate closely with workers in other departments on problems of mutual interest. Results of research are given to the producers of sheep, swine, and beef cattle through the medium of experimental field days often quite in advance of usual publication of research results.

Beef Cattle

Development of New Methods for the Evaluation of Breeding Stock Keynotes Beef Research

A simple, practical system of obtaining, recording, and evaluating weights of cattle is necessary if beef breeders are to make growth rate an important part of their selection programs. Animal husbandry researchers are cooperating in the use of privately owned purebred cattle raised under practical conditions in order to develop usable record and evaluation systems. Those systems now in use seem to be satisfactory since definite differences in the producing ability of cows and bulls are clearly indicated by the records.

The essential weights to be secured are at birth and at 6, 12, 18, and 24 months of age. The weights of the breeding stock should be secured at the beginning and end of the pasture season. Weighing each animal in the herd at the start and end of the pasture season seems practical for estimating all weights except birth weights. Further research may help to eliminate taking most of the birth weights. Reluctance on the part of many beef breeders to secure weights seems to stem from a failure to realize the amount of profit which may be secured by buying scales and taking weights. The investment in time and money for taking weights is not great relative to potential future net profits. (*Project C-14*)

Calves Vary Greatly in Rate and Economy of Gain

The primary purpose of the calf feeding study, in which the calves are fed individually, is to see if a method can be developed for an earlier evaluation of the rate and efficiency of gain of young bulls and heifers. Three year's work and the feeding of 75 calves have laid a foundation for the testing of sire groups of calves—work which is now being started.

TABLE 2—Records of Calves Fed Individually From About 202 to 370 Days of Age. (Group averages in pounds. T.D.N. refers to total digestible nutiients.)

Sex	Efficiency	Starting 202-Day Weight	Closing 370-Day Weight	Pounds Gained	Daily Gain	T.D.N. Per 100 lbs. Gain Plus Maintenance
Steers	Upper 1/6	412	750	338	2.01	508
Steers	Lower 1/6	354	610	256	1.53	552
Heifers	Upper 1/6	374	688	314	1.87	480
Heifers	Lower 1/6	353	555	202	1.20	655

Calves fed during the past three years have been used primarily to establish the soundness of the feeding and management practices to be used in the evaluation study. The method has proven sound. In addition results so far have demonstrated that beef breeders can make more profit if attention is paid to rate and economy of gains as shown in the accompanying table.

Since alfalfa hay is about 50 per cent digestible and corn is about 80 per cent, the differences as shown in T.D.N. are smaller than if the results were reported in terms of corn or hay. The 175 pound difference in T.D.N. between the upper and lower groups of heifers equals 219 pounds of corn. The upper one-sixth of the heifers gained 314 pounds. If their economy of gain had been as poor as that of the lower group of heifers, it would have cost 688 more pounds of corn to feed each heifer of the upper group. Savings such as these present challenges to beef breeders; first, to attempt to increase net profits by raising more efficient calves and second, to produce more beef with the present feed supplies.

Acceptable conformation doesn't always mean high daily gains and efficient use of feed, but all three can be had in one animal. A heifer such as the one at the left gained 1.74 pounds per day over a six-month period and used only 510 pounds of T.D.N. per 100 pounds gain. The heifer at the right has acceptable conformation, but averaged only 1.39 pounds per day and needed 589 pounds of T.D.N. for each 100 pounds of gain. The figures on the feed represent the number of 100 pound sacks of grain and 60-pound bales of hay needed for 100 pounds of gain.

Observations on the calves fed to date are extremely encouraging in that they confirm other observations indicating that it is possible to have, in one animal, good conformation, rapid and efficient gains, and the potential of a prime carcass. Conformation does not have to be sacrificed to get rapid, economical gains. (*Project C-14-a*)

Herd Classification Helps in Culling and in Furnishing Permanent Records of Conformation

Beef cattle have been judged on the basis of conformation for generations, yet more critical methods of evaluation and premanent record systems are needed. Apparently, few owners have accurate records of present or past animals in their herds. The herd classification work to date has indicated that simple records giving useful information can be secured without burdensome labor.

During the past year, the methods presently in use have been re-evaluated in an attempt to improve them. The need for the separation of (a) conformation, as such, (b) size or weight for age, and (c) condition of the animal has become evident. A new scale of values has been suggested not only to get a more definite separation among the gradations for various parts of the animal as far as conformation is concerned but, also, to divorce size and condition from evaluations of conformation.

The scales of values used in the past have been useful and of benefit to herd owners. The new scale being developed should be of greater assistance. Development of a new scale of points plus standardizations of values from person to person should assist greatly in communicating details of conformation. (*Project C-14-b*)

Search Continues for Closer Estimate of Carcass Value of Live Beef Animals

More accurate relationships need to be established between form on the hoof and in the carcass. Then selection of breeding animals for carcass quality may be more exact, since they cannot be made after the animal has been put into carcass form.

Data reported last year indicated that the actual weights of various wholesale cuts could be estimated with rather high accuracy by taking measurements on live beef steers. Further study of the data has shown that the relative emphasis given to any one dimension of animals should vary, as more or fewer dimensions are being considered at any one time. Some parts of the body were found to be correlated to a lesser degree with other parts than is generally recognized; yet other generally used relationships among parts were confirmed. Research has been started to study more of the interrelationships among various bodily parts as well as the relationships among various wholesale cuts. (*Project C-14-c*)

Bloat Research being Continued

The departments of animal husbandy and agronomy have completed a statewide survey of the bloat situation, and have received reports from 1,170 farms. About 750 farmers indicated that ladino clover was used for pastures. Eighty-three per cent of these reported trouble with bloat.

The incidence of bloat and the death loss from bloat has increased during the past three years. In 1949, 402 cases of bloat were reported in Maryland with 66 deaths. In 1951, 603 cases with 96 deaths were reported. The proportion of bloated cattle which were lost has remained rather constant at 14 to 16 per cent.

The bloated cattle included both beef and dairy stock. Relatively more beef cattle were lost, possibly because they require less care from farmers.

Visits were made to 85 farms to study the conditions and management practices under which bloat most frequently occurred. Bloat occurred on 55 of the farms visited. In 76 per cent of these cases, pastures were predominately ladino clover. This indicates that more grass is needed in pasture mixtures to reduce the chance for bloat. There is some indication that feeding hay or other roughages to cattle on pasture helps prevent bloat but this is not always the case.

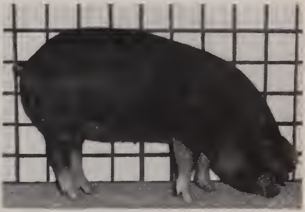
Soil and grass samples were collected from the Coastal Plain and throughout the state but further study is necessary to see if bloat is associated with soil nutrients or plant composition. (*Project C-18*)

Swine

Work Continuing on Development of Meat-Type Hog

The main effort in swine breeding during the past year has been to initiate studies on the rate and economy of gain of the Maryland No. 1 breed (Danish Landrace ⅝ × Berkshire ⅜) and to explore past records to find additional facts that breeders can use in evaluating swine herds. Results on rate of gain and economy of gain are not complete enough to report at the present time but appear to be satisfactory.

The effects of various factors on pre-weaning and weaning weights of the Maryland No. 1 pigs have been studied. Definite variations from year to year were found in birth weight but not in 21- or 56-day weights. Spring or fall (season of) farrowing had no effects. Older gilts and sows had heavier pigs at 21 and 56 days of age than younger gilts. In litters of more than six pigs, litter size had a definite effect on the size of the individual pig. Weaning records were found to be adjustable as follows: If gilts farrow at 11 or 12 months of age, add 2.6 or 1.3 pounds per pig respectively to bring the weights to a 13 month equivalent. If the litter contains more than six pigs, add 0.8 pound for every pig over six in the litter. (*Project C-8*)



Maryland No. 1 hogs such as this gilt have desirable conformation and carcasses with a high percentage of desirable cuts.

Method of Injection for the Quick Curing of Hams has been Tested

Every year our attention is called to the fact that many farmers are losing valuable pork products through spoilage and shrinkage losses. Various approaches have been tried during the past several years in an attempt to study methods of injection or curing of hams that would enable Maryland farmers to produce a quality product for home use without spoilage losses.

The method of regional injection developed, if followed carefully, will give a high quality product that remains sweet and wholesome under farm conditions until another year's fresh supply can be secured.

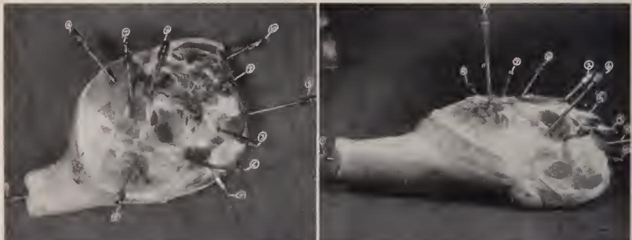
The hams were stitch pumped using an inexpensive small hand pump at the place indicated in the accompanying picture, with needle inserted at proper depth and angle. A 60° brine, composed of 8 pounds salt, 2 pounds sugar, 2 ounces saltpeter (sodium nitrate) and .02 ounce sodium nitrite to 6 gallons of cold water per 100 pounds of meat to be cured, was used for injecting the hams.

The amount used was 10 per cent of the fresh weight of the hams, or 32 ounces for a 20 pound ham. When 11 injections are used, 1/11 or approximately 3 ounces of solution would be pumped in at each site. If 8 injections were used 4 ounces of solution would be pumped in at each site. The hams were stored in the balance of the 60° brine for 14 days to complete the curing process. When 8 injections are made, the sites selected are at numbers 1, 2, 3, 4, 5, 6, 8, and 11.

Hams cured by this method with 8 or 11 injections showed an average salt concentration of 5 per cent, which is the concentration generally sought in country cured hams. The advantages of the regional injection pumping method are as follows:

1. The injection method provides rapid penetration of curing solution.
2. Curing can be accomplished irrespective of the way the ham is removed from the carcass.
3. Simple equipment is required, consisting of scales, an inexpensive hand pump and a barrel or crock for storing meat during curing.
4. The method can be followed without any previous training as it is very simple.

Farmers can use this simple method of curing country hams to secure much more uniform distribution of salt and to avoid much of the spoilage they have previously suffered. (*Project C-6*)



Top view (left) and side view (right) showing position, angle, and depth of needles for stitch pumping hams.

Animal Pathology

Studies Result in a Program for the Control of Infectious Bovine Mastitis

Infectious bovine mastitis has always been a costly problem of the dairy industry. Heavy losses occur to the dairymen each year through decreased milk production, loss of quarters and forced sale of animals for slaughter.

Studies are being carried out in about 40 herds throughout Maryland to determine and demonstrate the real value of various sanitation practices in controlling mastitis, and to make some observations on the value of treatment with various therapeutic agents. Cultural examination of the milk by means of blood-agar plates and identification of the organisms causing the disease have been employed in these studies.

Disposal of cows with unsound udders and separation of the diseased from the clean cows in the barn have been of practical value in many of the herds under study. In the light of the present research, the major requirements for a sound and satisfactory mastitis control program seem to be early and accurate diagnosis, appropriate treatment, and strict sanitation, together with rapid and complete milking. (*Project D-54*)

Search for Newcastle Vaccine Shows Progress

Research to find a satisfactory vaccine for Newcastle disease has continued. Modified virus was administered to chickens by injection into the muscle and by rectal swabbing. The latter procedure was tried to determine the immunity produced, and to determine whether further protection against both Newcastle and laryngotracheitis might be provided by combined treatment. Intramuscular injection of the vaccine caused disease in too many of the birds, but the survivors were solidly immune. The rectal method was safe, but the immunity produced was not strong enough for practical application.

The development of other modified vaccines was attempted in white mice, cotton rats, and large brown bats. The virus was examined under the electron microscope to find changes in shape and size caused by different methods of growth. In bats the virus was found in organs other than the brain. Further studies of this characteristic are to be made with the idea of changing the virus so that it will no longer cause the nervous symptoms which are characteristic of the disease under field conditions. If this character of the virus is removed, a more satisfactory vaccine may be developed. (*Project D-52*)

Studies in Anaplasmosis of Cattle

Anaplasmosis of cattle is an infectious disease which produces fever, loss of appetite, weakness, anemia, and jaundice. The onset of this disease is usually sudden. The mortality may range from 10 to 60 per cent in mature animals.

Every year anaplasmosis has been appearing in areas previously free from this disease, coming into new areas by the purchase of cattle that have recovered but continue to harbor the infectious agent in their blood. The infection may then be spread to susceptible animals by bloodsucking insects or by surgical operations where proper precautions are not taken.

A precedure known as the complement-fixation test has been used for the diagnosis of anaplasmosis and the detection of carrier animals. The results of these tests have been somewhat variable, due to variation in the test fluid. Through the work conducted by Station pathologists an improved antigen has been developed. Further application of the test to blood samples from infected herds will furnish needed information. (*Project D-50*)

Various Types of Vaccination for Brucellosis of Cattle are Compared

Vaccination with *Brucella abortus* Strain 19 vaccine has been shown to be of great value in the control and eradication of brucellosis (Bang's disease).

A survey has been made of several thousand animals vaccinated subcutaneously (under the skin) with a similar group vaccinated intracutaneously (directly into the layers of the skin), using one-tenth the amount of vaccine. The data obtained indicate that both types of vaccination produce a satisfactory resistance to brucellosis. However, intracutaneous vaccination produces a negative blood reaction more quickly, and much less vaccine is necessary.

Studies have been made to determine the optimum age for vaccination of calves. Greater resistance to brucellosis is developed when the animals are vaccinated from 6 to 8 months of age than when vaccinated at a younger age. However, calves vaccinated at eight months or over tend to retain their vaccination reactions to the blood test over a much longer period.

Vaccination of mature cows has been confined to infected herds and has proved to be of great value in preventing severe economic losses until such time as the owner is able to rebuild a clean herd with his own calfhood vaccinated replacements.

Revaccination of previously vaccinated animals with small doses of vaccine ("booster shots") appears to be somewhat effective, at least in maintaining resistance. In experimental groups, animals are being vaccinated at varying intervals to determine the best timing for revaccination. (*Project D-46*)

Enheptin Proves Satisfactory in Controlling Blackhead of Turkeys

Blackhead long has been a serious menace to the turkey industry of the state and nation. The ailment is caused by a small parasite scientifically designated *Histomonas meleagridis*. Current experiments by animal pathology researchers have thrown more light on the manner in which this parasite affects the body of the turkey.

The recently discovered drug known as enheptin (2-amino, 5-nitrothiazole,) continues to prove satisfactory in controlling the disease. Observations made at the University of Maryland indicate that powdered enheptin fed in the mash is somewhat more effective than liquid enheptin administered in water. The so-called low level, (0.05 per cent) has been somewhat more effective than the high level (0.1 per cent) concentration of the drug sometimes recommended for treatment.

Investigational work conducted during the present year has indicated that, while turkeys are protected by enheptin, they do not form immunity during the treatment period. The effect of treatment, therefore, lasts only as long as the drug is given. Additional experiments are in progress to find still other effective and economical forms of treatment for blackhead. (*Project D-51*)

Botany

Research in the Department of Botany proceeds along several specific lines. Among them are plant breeding, plant physiology, and plant pathology.

The plant breeders combine their knowledge of the basic laws of heredity with practical knowledge of the needs of Maryland farmers in an effort to improve crop plants and to develop new and better varieties.

Plant physiologists are continuing to explore the basic laws governing leaf analysis as a guide for fertilizer applications. Recently they have initiated studies on boron which show that this essential trace element is involved with the movement of sugar from the leaves of plants to other parts of the plant.

The research work of the plant pathologists centers around control of the diseases which attack vegetables and canning crops, tobacco and field crops, fruits, trees and ornamental crops. Research to develop strawberry varieties resistant to the several strains of the red stele fungus continues with many promising seedlings under extensive field tests. The pathologists are also working to further improve spray programs and chemical treatments for seed and soil through experiments on the fundamental laws governing the way in which fungicides work. Recently new research has been initiated on the use of fungus-produced drugs, somewhat like penicillin, for the control of plant diseases.

Plant Breeding

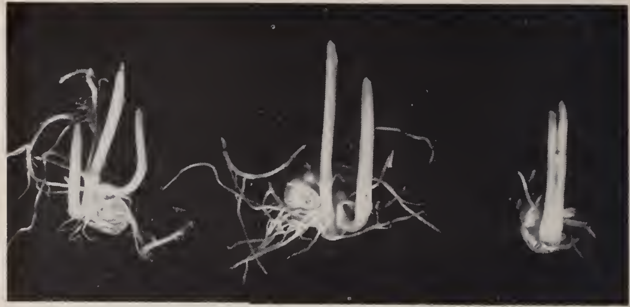
Basic Studies Made on Breeding New Plant Varieties

New varieties of plants are most requently developed by systematic rossing of older varieties of the same lant species. Occasionally, in order o achieve a desired objective, it is ecessary to cross different species. uch interspecific crosses are generaly much less successful in producing eed than are crosses between varieies of the same species. Maryland ytologists are investigating crosses nvolving different species of lilies in rder to obtain useful basic informaion on the hybridization of this lant. Some successful interspecific rosses, not previously reported by ther research workers, have been obained this year.

An increase in the number of chromosomes, the carriers of the hereditary units, often results in altered growth habits of the plant. Maryland plant breeders have recently treated the asparagus variety Mary Washington with the chemical colchicine in order to obtain plants with increased chromosome number. Plants with twice as many chromosomes as normal have been obtained. These are being increased vegetatively in order to obtain a sufficient number of the new chromosomal type for field evaluation. (*Project F-9*)

The Multiple Seedling-Haploid Method of Plant Breeding Tested on Tomatoes, Peppers, and Corn

Individual seeds that produce more than a single seedling have been found in pepper, corn, tomato and lily by the plant breeders of the Botany



Multiple seedlings of corn are used to develop improved, true breeding lines as reviewed in the text.

Department. Twin seedlings from individual seeds have been frequently observed. Triplet and quadruplet seedlings are less common.

The research workers have determined the origin of the twin seedlings. Often one member of a multiple seedling arises directly from the female parent without any hereditary contribution from the male parent. Such plants are called haploids and have only one-half as many hereditary factors as typical plants. Treatment of the haploids with the chemical colchicine results in the duplication of the single set of hereditary factors and produces individuals which breed true.

Utilizing this method, thirty different lines of peppers have been developed by the Maryland plant breeders. The most promising of these lines are being observed for commercial qualities this year. The established lines have been utilized this year in producing hybrids in order to determine the value of hybrid vigor in peppers.

The basic principles obtained from the studies of peppers are being extended to other crop plants and research studies are being initiated in corn and tomato. Preliminary studies with tomatoes indicate that twin seedlings occur with approximately the same frequency as in some pepper varieties. Several twin seedlings have been obtained in the variety Rutgers. Approximately 100,000 tomato seedlings will be observed for twins this year. (*Project F-15-A*)

Plant Physiology

Leaf Analysis Tested as a Guide for Fertilizer Applications

As a continuation of the research to correlate leaf analyses with the ultimate yield of plants, over 200 additional samples of tobacco are being analyzed. Although the development of precise "sufficiency values" for nitrogen, phosphorus, potash, etc., is obviously a long-range project, tentative sufficiency values may soon be established for certain elements in tobacco, and possibly certain other important crop plants in Maryland. (*Project K-8-B*)

Boron as a Factor Affecting the Rate of Respiration in Plants

While plant physiologists at this station were testing an idea as to the role of boron in plants, it was observed that as few as 5 ppm. of boron brought about a 50-85 per cent increase in the rate of respiration of starved plant tissues given an external source of carbohydrate. Later research indicated that boron increases the diffusion of externally-supplied sugar to the respiring tissues. The increased rate of respiration was not a direct effect of boron on the respiratory mechanism.

Sugar, and starch in particular, may be stored only in certain portions of a fruit or vegetable. Since these storage tissues supply the rest of the fruit or vegetable with sugar, the significance of boron in preventing starvation and death of isolated groups of cells is readily apparent. At least some cases of "physiological breakdown" and internal spot of fruits and vegetables during storage may be caused by an inadequacy of boron in the tissues and a consequent failure of sugar to move to all of the cells from tissues where sugar and/or starch are stored. (*Project K-7*)

Boron Found Necessary for Movement of Sugar in Plants

It was first established in 1910 that plants require boron, and since then the deficiency symptoms of plants lacking boron have been determined for many horticultural and agronomic crops, including such "diseases" as cracked stem of celery and cracking and black-heart of beets. However, scientists have been unable in the past to determine the specific manner in which boron functions in plants.

Recently plant physiologists at this station obtained indirect evidence that boron is involved in the movement of sugar (sucrose) from cell to cell. This evidence has been directly confirmed by the use of radioactive sucrose, which has become available as a result of the research in atomic energy. In the absence of boron very little sugar entered through a tomato leaf immersed in sugar solution and the sugar which did enter stayed primarily in the stem near the treated leaf. Plants exposed to sugar plus boron took up large amount of sugar and the sugar proceeded to the stem tip and young, developing leaves which are known to require large amounts of sugar in their respiration and growth.

The autoscaler, a type of geiger counter, is used to trace the path of radioactive materials through plant tissues. The use of radio-active materials in plant nutrients allows the exact amount in any part of the plant to be measured.

The researchers conclude that in the absence of boron sugar is formed as usual in the leaves, but that it may not move to the stem and root tips and to the flowers and fruits. The dying of stem and root tips and the dropping-off of aborted flowers and fruits under a deficiency of boron would be readily explained on the basis of this fundamental research. (*Project K-8-B*)

Plant Diseases

Yield and Quality of Vegetable Crops Increased by Spray Programs for Disease Control

Improvement in quality and increases in the yield of tomatoes in Maryland in recent years may be attributed in large part to more efficient control of the major fruit and foliage diseases. Better disease control has resulted from the more general use of a regular program of fungicidal sprays.

The tomato disease control program has been developed by plant pathologists on the basis of results of their research in the field and laboratory. The effectiveness of the spray program is illustrated by one grower-canner who realized $100 per acre net additional gain over unsprayed tomatoes as a result of using an 8-application spray program on tomatoes in 1951.

A spray program has also been developed for control of fruit and foliage diseases of cucurbits and the possibility of controlling field diseases of peppers has been studied in field plots.

Plant pathologists continue to study new fungicidal materials and new combinations of fungicides in an effort to improve the spray programs now recommended. (*Project J-87*)

Research, Continued and Expanded on How Fungicides Work

Plant pathologists do not overlook the fundamental aspects of plant disease control while working on projects which have immediate application in the field. Fundamental research has shown, for example, that one of the common fungicides, chloranil, controls fungi by preventing the proper functioning of two enzyme systems which are necessary for these pathogens to grow and attack the roots of plants.

Another organic fungicide, thiram, apparently inhibits an entirely different, but equally essential enzyme system in pathogenic fungi. There is evidence that certain fungi may produce materials which inactivate fungicides. This may explain why certain plant diseases are well controlled by one fungicide but poorly controlled by another.

Research of this type should lead to the more effective use of fungicides and provide the basis for development of better fungicidal chemicals. (*Project J-87*)

Progress Made In Identification and Control of Plant Virus Diseases

Virus diseases cause great losses to Maryland crops every year and are often limiting factors in the production of strawberries, tobacco, potatoes, peaches, and tomatoes. Tobacco mosaic accounts for 30 to 65 per cent of the annual loss in quality of tobacco due to disease.

Research on virus disease control is relatively new and includes both the basic and applied fields of research. Further work on the sub-projects listed below has been continued.

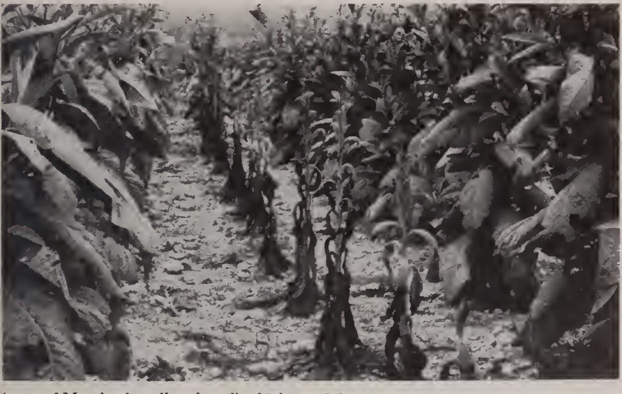
1. *Leaf roll of potato.* The indexing method, although 95 per cent reliable on heavily infected stored tubers, is not reliable when applied to current season's growth.
2. *Strawberry viruses.* Field tests have been made to control insect vectors. Several strawberry varieties have been found tolerant to the virus complex. Virus-free plants have been supplied to nurserymen from which new superior planting stock is being developed.

3. *Stone fruit virus disease.* Surveys indicate peach yellows has continued to be destructive in Maryland orchards. Phony peach has not been found. Previously unreported cherry yellows has been found on sour cherry. Work on obtaining disease-free stock, control of insect vectors, and destruction of diseased trees is continuing.
4. *Sources of tobacco mosaic and its control.* It was found that heating shredded stalks and refuse to 212°F. for 15 minutes at 32 per cent moisture content will inactivate this virus.
5. *Development of resistance to tobacco mosaic.* This work being done cooperatively with the agronomy department indicated that 17 strains selected from 1951 warranted further testing. Some strains were grown in each of the five counties to compare them with growers' strains.
6. *Leaf curl virus of tobacco.* This disease has been graft-transmitted to tomato, Turkish tobacco, 448-A mosaic-resistant tobacco, and jimson weed. A survey in 1951 indicated that this disease has disappeared from tobacco fields in Maryland. (*Project J-88*)

Resistant Strains of Tobacco Best Means of Disease Control

Most of the major diseases of tobacco are found in the field. Some of these such as wildfire, anthracnose, black root rot, and tobacco mosaic start in the plant bed and can be controlled by proper management spraying or dusting soil pH control, soil fumigation, and sanitation. Once these diseases enter the field very little can be done to stop their spread.

It is difficult to control field diseases of tobacco by using sprays, dusts, or soil fumigation. The best and most effective method both for plant bed and field is to develop



A row of Maryland medium broadleaf tobacco dying of black shank disease between rows of two resistant selections resulting from crosses between Maryland and Florida 301.

The newly developed tobacco variety at left is resistant to mosaic, wildfire, and root rot. It is free of mosaic and more vigorous than the susceptible variety at right.

strains resistant to disease by breeding.

In Maryland resistance in tobacco has been developed against Fusarium wilt and black root rot. Development of resistance to mosaic, wildfire, black root rot, black shank and anthracnose has been started. If Granville wilt continues its spread, as it did in 1951, resistance to this disease will be a "must" for the program. In 1951 black shank and Granville wilt were found in three of the five major tobacco growing counties of Maryland.

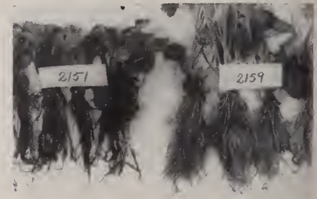
Development of resistance to mosaic has reached a point where some of the strains resemble Maryland types; however, further selection is needed. This work, along with selection for root rot and wildfire resistance, is being carried on cooperatively with the agronomy department. Some strains of tobacco have been developed with high resistance to black shank, but it will require several years of selection before a good Maryland type can be expected. Screening tests are in progress to find a soil fumigant that will prevent the spread of black shank. One test has been made in a black shank infested field.

About 25 species of *Nicotiana* were screened to find resistance to anthracnose; none of them were immune. However, some of the species were highly tolerant to the disease and these will be crossed with Maryland in an attempt to obtain some resistance to the anthracnose disease. (*Project J-89*)

Breeding Strawberries for Resistance to the Red Stele Disease

Occurrence of new strains of the fungus causing red stele of strawberry presents a serious problem to the program of breeding resistant varieties. Another race of this organism appeared during the 1952 season in which strawberry seedlings were grown in greenhouse beds containing infested soil collected in Maryland. Thus, in Maryland there are at least three strains differing widely in their ability to attack different varieties of strawberries. The economic significance of these strains was clearly evident in parts of Maryland when the formerly resistant Temple variety became severely infected with red stele.

Since the possibility of such an occurrence had been anticipated, the breeding program carried on cooperatively with the U.S.D.A. has attempted for several years to combine resistance to the several races of the red stele fungus in the new strawberry progenies. As a result, several very promising selections have been



Comparison of a susceptible strawberry seedling (2151) with a newly developed selection (2159) which now carries resistance to several strains of the red stele disease.

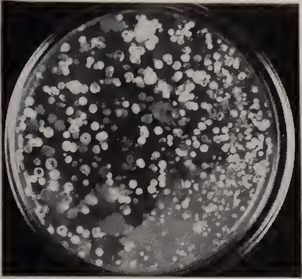
obtained which are resistant to the present races of red stele as well as to leaf spot, leaf scorch and powdery mildew. Of these selections, Md.-U.S. 2159 appears outstanding and is being propagated for extension trial in the red stele areas. Several other selections having such multiple resistance have also been obtained.

Of 5,000 seedlings fruited this year, 118 were selected for further testing. A new planting of 5,500 resistant seedlings was made.

This research has been revised to include more work on the nature and occurrence of new strains of the red stele organism and to study control of diseases by newer technics such as chemotherapy and antibiosis. (*Project J-78-A*)

Methods of Controlling Sweet Potato Diseases Studied

Since several organisms causing diseases of sweet potatoes can survive in soil for a long time, the use of soil fumigants as a control measure may become necessary. Accordingly several chemicals commonly used for this purpose were applied to infested soil in the Salisbury area.

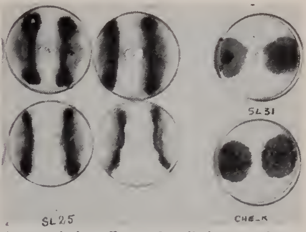


To obtain organisms from the soil a minute quantity of soil is placed in a culture medium in a culture dish. After a few days incubation many individual organisms can be isolated from the various colonies. These isolates are then tested for antagonism to the sweet potato black rot fungus.

Studies were continued on the possible use of antagonistic organisms for control of sweet potato black rot. Of 96 microorganisms screened for antagonism 25 were found to cause reduction of growth of the black rot fungus on agar media. (*Project J-86-A*)

Search Continued for Disease Resistant Varieties of Potatoes Adapted to Maryland Conditions

Plant pathologists continue their search for potatoes which will resist the diseases that occur in Maryland and at the same time will produce good yields of high quality tubers. At the present time Kennebec almost fills the bill, being late blight-resistant and of good quality. It also yields well, especially on lighter soils. It performed well in both early and late plantings. Ontario, which is scab-resistant, and Sebago also showed promise as late varieties. At higher elevations in western Maryland, La Sota, Marygold, and Potomac were among the highest yielders, but the scab-resistant Yampa and Ontario as well as Kennebec also performed well. (*Project J-90*)



Antagonistic effect of soil isolate SL-25 when grown in culture with the sweet potato black rot fungus. The six plates on the left show how the normal circular pattern of growth is "flattened" by an antagonistic substance emanating from the test organism in the center of the dish. At the upper right is a non-antagonistic isolate SL-31 and at the lower right is a plate containing only two colonies of the black rot fungus.

Dairy

Dairy Production

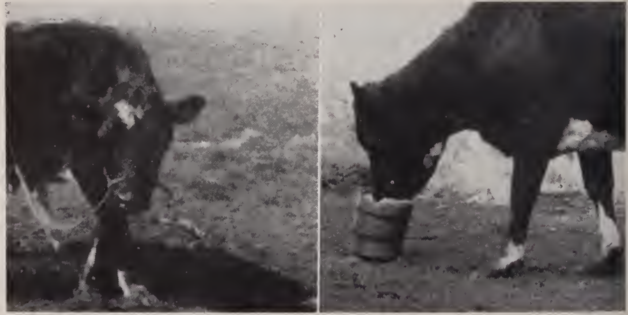
Research Uncovers Additional Information on the Cause of and Treatment for Ketosis (Acetonemia)

Ketosis, or acetonemia, is a troublesome and costly condition occurring in cows most frequently within a few days to a few weeks following calving. It is associated with the improper functioning of the adrenal and pituitary glands. The improper functioning of these vital endocrine glands apparently is due to unknown stresses which occur at calving time and during the period immediately following calving.

During the year detailed studies were made on more than 60 cows treated with one of the materials discussed below. Not all of the cases diagnosed as ketosis in the field were found to be true ketosis. Some cows had ketosis complicated by other disorders or infections. In these cases, the effectiveness of the treatment for ketosis depended upon the other disorder being treated at the same time.

Most cases of ketosis recovered quickly and without relapse after a single injection of either corticotropin (ACTH) or cortisone (1½ grams of cortisone or 300 Armour units of ACTH). Several cows which had collapsed completely and would not respond to any other known treatment recovered quickly with these materials. Since cortisone and ACTH have been fairly expensive a number of related materials were tested to determine their effectiveness in the treatment of ketosis.

Two intermediate products in the synthesis of cortisone showed some activity and hold some promise as an effective treatment. A new preparation of ACTH was found to be ex-



Left—Cow with ketosis before treatment with adrenocorticotropin (ACTH) Right—Same cow 24 hours after treatment. The marked improvement noted here is typical of the use of ACTH, cortisone and compound F, treatments developed by dairy scientists at the University of Maryland.

Cortisone being injected into a cow with ketosis (acetonemia). Dairy scientists were the first to use cortisone and ACTH to treat the disorder.

tremely effective. Compound F, a substance closely related to cortisone, was found to be from two to three times as potent as cortisone. On the other hand, compound A was ineffective.

In previous studies a combination of dextrose and cortisone appeared to be more effective than cortisone alone. Studies during the past year have shown that when either ACTH or cortisone were used in sufficient amounts recovery was rapid and no increase in the rate of improvement was demonstrated by the addition of dextrose.

The feeding of sodium acetate increased the blood sugar level of cows with ketosis to normal in only 10 to 15 per cent of the cases treated. This proved too slow and was effective in too few cases to be used as the principal treatment. Sodium propionate was much more effective. Blood sugar increased rather quickly following treatment, but several days usually elapsed before the cow improved clinically. When used in combination with cortisone or ACTH, propionate may have a place in the treatment of ketosis.

An injection of adrenalin activates the pituitary gland of the normal animal and causes the secretion of ACTH. This is accompanied by a decrease in certain white blood cells called eosinophils. Animals which have been subjected to severe stress may suffer pituitary failure and not show the changes in eosinophils following the injection of adrenalin. Dairy research workers at Maryland have used this procedure to test cows and found that cows with ketosis failed to respond to injections of adrenalin. On the other hand, normal cows injected with adrenalin showed the normal response. This is an additional link in the chain indicating that ketosis results from a failure of the pituitary and adrenal glands to function normally because of unknown stresses.

When ACTH or cortisone was injected into cows with ketosis the blood eosinophils decreased sharply. The feeding of sodium propionate also caused the eosinophils to decrease but at a slower rate. These results indicate that the response obtained when sodium propionate is used as a treatment for ketosis may be the result of a stimulating effect on the pituitary and adrenal glands.

The feeding of sodium acetate also decreased the eosinophils but to a lesser extent than propionate. Since the acetate and propionate are normally produced in the rumen of the cow, extensive studies are being conducted on the chemistry and bacteriology of the rumen. Although no evidence of abnormalities in the chemistry or bacteriology of the rumen of cows with ketosis has been determined to date, these studies will be continued. (*Project G-37*)

Intravenous Injection of Dextrose Has No Effect on Milk Production and Butterfat Test of Normal Cows

Relatively large amounts of dextrose have been used as a treatment for ketosis and other conditions during recent years. A question has been raised concerning the effect of intravenous injections of dextrose on the milk production and butterfat test of normal cows. In a study with fourteen normal milking cows, the injection of from 250 to 500 ml. of 50 per cent dextrose over a period of six days did not affect milk production or butterfat test. (*Project G-37*)

Studies Underway to Determine Fat Requirements in the Dairy Ration

Feeding experiments have been continued to determine the effects of different levels of fat intake by the cow, and to test previous indications that there is an optimum level of fat intake. Studies during the past year showed that the butterfat test and total butterfat production can be increased for a two-week period by increasing the fat intake. Work now in progress should reveal whether this increase may be maintained over a period of time. (*Project G-38*)

A group of identical twin heifers which will be used for studies on the nutritive requirements of milking cows. Because of the genetic similarity, information obtained on one set of identical twins is as valuable as the same information from approximately 20 less closely related animals.

Tests Measure the Nutritive Value of Alfalfa Hay

Feeding trials during the past year confirmed previous findings that good quality alfalfa hay is not deficient in any nutrients needed for milk production other than energy. Seventeen cows were used in comparing a ration of alfalfa hay alone with a ration of alfalfa hay and ground corn.

Cows fed alfalfa hay alone did not consume enough energy to maintain high milk production. However, energy was utilized as efficiently by the cows fed hay alone as or those fed alfalfa hay and corn. In formulating a grain mixture to feed with good quality alfalfa hay, primary emphasis should be placed on supplying energy in a palatable and economical form. (*Project G-39*)

New Methods of Measuring Digestibility Tried

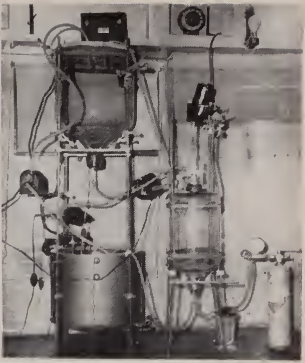
An effort has been made to develop more accurate methods of measuring the nutritive value of various feeds. A number of different chromogens (colored pigments) were extracted from hay and corn before feeding. The feces of the cows that consumed these feeds were extracted in order to recover as many of these pigments as possible. Additional research along these lines is underway to determine whether any specific chromogen may serve as a more efficient indicator in the determination of digestibility. (*Project G-39*)

Milk Secretion May Depend on Blood Flow to the Udder

Research has been continued with the artificial heart-lung perfusion apparatus which was described in the 64th Annual Experiment Station Report. This apparatus has been used to pump both natural and artificial blood through udders removed from cows immediately after slaughter.

Previously it was reported that the addition of too much oxygen to the blood caused vasal constriction which resulted in a reduced flow of blood through the udder. Recent work has shown that this problem is eliminated by adding 5 per cent carbon dioxide to the oxygen used for oxygenating the blood in the artificial heart-lung. Adding chloral hydrate to this blood also prevented this constriction of the blood vessels.

The perfusion technique has now been perfected to the extent that radioactive tracer substances can be used in the study of formation of various milk substances in the udder. Recent work makes it appear probable that decreases in milk production, which occur when there have been no changes in the feed intake of the cow, may be due to a decrease in rate of blood flow through the udder. (*Project G-45*)



The newest modification of the artificial cow developed at the University of Maryland for use with radioactive tracer substances to determine how milk is made. This apparatus is mounted in a trailer equipped as a laboratory so it can be moved from place to place as is required in these studies.

Dairy Technology

Chemical Changes in Milk Fat Related to Flavor in Dairy Products

Most dairy products containing milk fat may develop off-flavors due to chemical changes in the fat during processing and storing. Dairy researchers have been making a study of the fundamental chemistry involved in these changes to get a better understanding of the problems associated with off-flavor development.

Rancid flavor has been particularly troublesome in the fluid milk market. This flavor is due to a partial hydrolysis of the fat which yields free fatty acids which cause the rancid flavor. The enzyme lipase, which is normally found in raw milk, is responsible for the hydrolysis. Although this enzyme is inactivated by pasteurization, rancid flavor is often encountered due to lipase action prior to pasteurization.

It has been reported that the milk given by cows during the estrum period is very susceptible to a rancid flavor development. A study was made of milk given during both natural and induced estrus. The amount of free fatty acids in the milk and the lipase activity were found to increase during the estrum period. The highest point in lipase activity was reached on the day estrus was observed, while the peak of free fatty acids occurred the following day. Injections of the synthetic hormone, diethylstilbestrol, were used to induce estrus. This induced estrus resulted in a very rancid milk.

The flavor caused by oxidative degradation of fat is also a troublesome problem in many dairy products. Research is underway to determine the chemical nature of the various compounds formed in oxidized milk fat. Colorimetric tests are used in quality control work on oxidized flavor. The pure compounds in oxidized fat which are responsible for some of these colorimetric tests have been isolated. Work on the identification of these compounds is now being conducted.

A compound with the empirical formula $C_8H_{14}O_2$, in which at least one of the oxygens is carbonyl, has been isolated from oxidized milk fat via its 2,4-dinitrophenylhydrazone. This compound seems to be representative of a class of compounds found in oxidized fat which is responsible for the Kreis and Thiobarbituric Acid tests. These tests are commonly applied in studying the progress of fat oxidation.

Continued research on this problem may lead to a more reliable qualitative test for fat oxidation, and help explain the fundamental changes that occur in the development of the oxidized flavor in milk. Answers to these problems will greatly facilitate the application of practical milk quality control measures. (*Project G-34*)

Flavor Compounds in Cheddar Cheese Investigated

Dairy researchers have continued to study the mechanism of cheddar cheese ripening, with particular attention to the chemistry of the compounds responsible for flavor. The free fatty acids formed in cheese during the curing period are believed to be responsible, in part, for the characteristic cheese flavors. A method involving chromatographic procedures has been developed which analyzes the amount of each of the volatile fatty acids in cheddar cheese. Acetic, propionic, butyric, caproic, caprylic and capric acids have been found in all cheddars examined. A comparison of the analytical acid values with the flavor score of cheese is being made.

A class of compounds which has previously received little attention in cheese study is the carbonyl group. Research has demonstrated that there are a variety of carbonyl compounds in cheddar cheese. To date, acetaldehyde and propionaldehyde have been identified in cheddar and work is progressing on the identification of the other members of this class of compounds. (*Project G-35*)

Discoloration Due to High-Temperature Treatment of Dairy Products is Studied

Dairy products such as evaporated milk and some powdered milks are processed with temperatures in the range of 200-300°F. Although there are advantages for this high-temperature treatment, cooked flavor and brown discoloration result from the process. Research is being conducted to isolate and identify the substances associated with the curd in heat-coagulated milk. Various methods of extracting the curd have been used to isolate these substances. Particular attention is being given to a study of the brown colored substance present in heated milk.

In several instances elemental sulfur has been extracted from the curd of milk which was autoclaved for two hours at 15 pounds steam pressure. Experiments are being conducted to ascertain whether the free sulfur is formed during extraction of the curd or whether it is present in the heated milk.

Preliminary qualitative observations of the brown material extracted from the curd indicated that it contains nitrogen but no sulfur. The brown material, when freshly isolated from the curd, is a gummy syrup. When dried it loses nitrogen and leaves a tan crystalline substance of a much lighter color than the original extract. The crystalline material gives a dark brown color in alkaline solutions and also in acid solutions containing the ammonium on Study is progressing on identification of the compounds involved in this color formation. (*Project G-40*)

Calcium Sulfate Effective in Producing Ice Cream for Special Handling

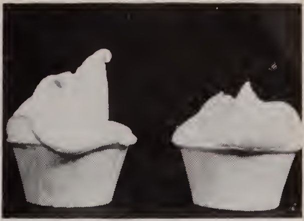
The ice cream industry has shown considerable interest in a product that can be used to make a dry, stiff ice cream. A finished ice cream possessing these characteristics is highly desirable in articles such as cake rolls, ice cream sandwiches, novelties and other products that require special handling.

Experiments have been conducted to determine the effects on the properties of the ice cream mix and the finished ice cream when various amounts of calcium sulfate are used.

Results show that calcium sulfate, when used in ice cream mix, produced a dry, stiff ice cream with slower melting properties. These characteristics were observed when calcium sulfate was used in amounts of 0.08, 0.12, 0.16 and 0.20 per cent in conjunction with some of the common ice cream stabilizers.

Observations of the properties of the mix and the finished ice cream showed that 0.12 per cent calcium sulfate gave optimum results in the mixes studied.

Results indicate that calcium sulfate can be used satisfactorily in the manufacture of a dry, stiff ice cream. (*Project G-42*)



Addition of 0.12 per cent calcium sulfate was found to produce a dry, stiff ice cream with slower melting properties. Left—Ice cream containing 0.12 per cent calcium sulfate. Right—Ice cream containing no calcium sulfate.

Stabilized Fruits Make Better Ice Cream

Stabilizers are added to ice cream mix to give a smooth texture to the finished ice cream. Stabilizers are of animal or vegetable origin, such as gelatin or algin and gums. They function by absorbing some of the free water and preventing the formation of large ice crystals in the ice cream.

Recent studies of the effect of different stabilizers on strawberries and finished ice cream indicate that more fruit juice was retained by the stabilized berries. The fruit had a more desirable appearance in the ice cream, and there was less bleeding of the fruit when proper stabilization was practiced. Stabilization resulted in better berry distribution.

The desirable effects of fruit stabilization have been observed when products with CMC, pectin, or algin derivatives were used. These effects were more pronounced in berries packed with 3 or 4 parts of berries to 1 part of sugar than when the sugar content of the pack was greater. (*Project G-42*)

Entomology

Pest Control Necessary For Good Azaleas

Research on the insect pests of the azalea has resulted in a complete program of spraying that so far has given excellent results. Pests included in the tests consisted of the azalea lace bug, the red spider, the white fly, the leaf roller or miner, and two scale insects—the scale *Erococcus azaleae,* Comst. and the soft scale *Pulvinaria ericicola,* McC. It has been found that the important point with regard to the control of red spider, white fly and lace bugs is to get an application of the foliage prior to blooming. After the blossoming period is over, two applications have kept azaleas free of these three pests. Special applications of summer oil are found necessary for the control of the scale insects. The control of azalea pests has been prepared for the azalea handbook now being published by the American Horticultural Society. (*Project H-35*)

BHC Found Suitable for Fly and Mosquito Control in Cities and Towns

Many cities and towns throughout Maryland have inaugurated programs of space spraying for the control of flies and mosquitoes. The insecticides commonly used in this work are DDT and Lindane. In many areas flies have become resistant to DDT and this insecticide is no longer fully effective. In such areas it has been found that Lindane gives effective control, but because of its rather high price there is interest in a cheaper insecticide. From the standpoint of cost, BHC offered possibilities, but because of its musty odor there has been doubt concerning its use for this purpose.

During the summer large scale tests were made in three tidewater towns. BHC was used to replace DDT and Lindane in one or more sprays. In one large town the material was used throughout the season. Excellent fly and mosquito control was obtained in all instances and no complaints were received from residents regarding its odor. (*Project H-52*)

Better Recommendations for Greenhouse Insect Control

Research on control of mites in the greenhouse is continued. New miticides are being compared with the older ones as they become available. Of the six species of mites that have been found in our greenhouse only two have been very numerous. These two have been used in most of the testing work. This year a study of the life history of one, *Brevipalpus australis,* Tucker, has been worked out. When opportunity offers, tests are being conducted on the control of slugs in the greenhouse. The usual recommendations are not entirely satisfactory and research continues for improved methods. (*Project H-50*)

New Insecticides Show Promise in the Control of Pea and Bean Insects

Research for a more satisfactory insecticide to control pea aphids has been successful. The organic insecticide designated as experimental material 4049 and now marketed as malathon was highly effective against the aphid in small plot experiments. It is much less hazardous to handle than parathion and the residue does

The "Irons" tomato boom, with nozzles at top and both sides is designed to give the thorough coverage needed in applying fungicides. It is being used here in experiments on spraying cucumbers.

not persist as does DDT. There was no detrimental effect to the plants, and plots receiving a malathon emulsion spray outyielded those receiving other treatments. This insecticide will be used on limited commercial acreages next season both by ground sprayers and by aerial application.

The systemic organic phosphorous poison, octamethyl Pyrophosphoramide also gave satisfactory protection from aphid attack when applied as a seed treatment but germination and stand were reduced 25 to 30 per cent and residues persisted in the vine and seed at harvest time. Because of persisting residues this insecticide will not be used further in experimental work or recommended for commercial use. (*Project H-29-6*)

Dilan and Malathon give Excellent Control of the Mexican Bean Beetle

A number of insecticides in sprays, dusts and aerosols were tested for the control of insects on both snap and lima beans. Of the new materials Dilan and malathon gave excellent results. Snap beans treated with Dilan sprays and aerosols grew vigorously and produced large high quality fruit. This insecticide gave excellent control of Mexican bean beetle, leafhoppers and flea beetle. It was not effective against the black bean aphid and against red spider.

Malathon sprays and aerosols gave good Mexican bean beetle control and were effective against all other insects present on both snap and lima beans. In sprays and aerosols this material caused no detrimental effect on the plants and seemed well adapted for use on lima beans.

More experimental work is needed before the relative value of these two new poisons can be correctly determined. It is recommended that growers try these materials in a limited way this year. (*Project H-29-g*)

Concentrated Aerosol Sprays Tested for Truck Crops

During the past year, some of the newer insecticides were tested in self propelled liquefied gas sprays against insects on several vegetable crops. Valuable information was obtained on performance against a large variety of insects, on degree or injury to the plants and on resulting yields of crops.

Dilan was found to be highly effective against most Coleoptera and especially effective against leafhoppers on all crops used. It was found not to be a good aphicide; aphids of various species became numerous on Dilan treated potatoes, tomatoes, cabbage, beans, and cucurbits.

Dieldrin proved to be an excellent cucurbit insecticide. Plants treated with this poison grew vigorously and produced high yields of fruit, and it appeared to be generally effective against cucurbit pests.

Lindane gave the best general performance against all insects on all vegetables grown for these tests. There was no harmful effect on the plants, but the flavor of some crops was slightly affected. Further studies must be made on the flavor of lindane treated vegetables. Chlordane and aldrin showed no particularly meritorious results and the former appeared to produce slight stunting of some crops. Other insecticides and combinations of insecticides will be tested during the coming year. (*Project H-46-a*)

Several Insecticides Give Satisfactory Japanese Beetle Control

There has been considerable demand for information on the relative efficiency of the many insecticides now on the market and recommended for Japanese beetle control. To meet this demand, a study was made to determine the general usefulness of the more promising of these materials. The studies involved dosage, spread of knockdown, and lasting residual qualities.

DDT, Chlordane, Toxaphene, methoxychlor, TDE, aldrin, and dieldrin were tested. When used at the rate of from 1 to 15 pounds of actual insecticide in 100 gallons of water all these chemicals were found to be satisfactory for control. All beetles contacted by the sprays were killed.

Beetles coming to sprayed foliage were usually killed for a period of from 5 to 10 days following application. Doubling the above dosages increased the lasting qualities of residues. Beetles coming to sprayed foliage within three weeks after the heavier application were usually killed.

Toxaphene was slightly less effective than the other chemicals. For a practical application, the amount of this material should be increased so that at least 1.5 pounds of the actual chemical is used with 100 gallons of water.

Lindane and BHC sprays gave excellent kills and very rapid knockdowns. These two materials were among the most efficient of all the chemicals tested. Parathion was also outstanding as an insecticide for killing beetles.

The "Slosser" row crop boom is used in low volume spraying experiments for control of the Mexican bean beetle. The nozzles are carried on runners which slide on the ground and are always at the proper level to insure good coverage.

A relatively new insecticide known as Dilan, used at the rate of 1 part in 600 parts of water gave excellent kills, and the residual deposits on sprayed foliage were efficient for killing beetles for from six days to a week. Another new insecticide tested and found efficient for killing beetles was Metacide. (*Project H-41*)

Low Gallonage Sprays Effective in Japanese Beetle Control on Corn

The effectiveness of low gallonage sprays for the control of Japanese beetles on corn was studied during the year. These sprays were applied with airplanes and high clearance ground equipment.

With the airplane, excellent kills were obtained where two to five gallons of carrier were used to disperse the proper amount of insecticide. Water may be used as a carrier for insecticides in airplane application, but best results are obtained when oil is used. White mineral oil, paraffin base superior type oils with viscosities of around 100 Saybolt, and No. 2 fuel oil, were all used in airplane spraying up to 5 gallons per acre without injury to corn. Fuel oil is not generally recommended.

With ground machines low gallonage sprays at the rate of 5 to 25 gallons per acre were found to be effective. Because several factors, especially high wind, may have an adverse effect on extremely low gallonage sprays, 10 to 15 gallons are the minimum amounts generally recommended. It may be desirable to spray for the control of other insects such as European corn borer at the same time. When this is done 20 to 25 gallons of spray to the acre are required for satisfactory control of both the Japanese beetle and European corn borer. (*Project H-41*)

Effects of Soil Conservation Practices upon Animal and Insect Populations under Study

A long period study is underway in cooperation with the Patuxent Refuge of the Fish and Wild Life Service and the Soil Conservation Service to find out just what effect soil conservation and game management practices have on the population of beneficial and injurious insects. Numerous collections and samples of insect populations have been identified and classified this past year. Results should soon be sufficient to justify a complete report. (*Project H-56*)

Nectar Resources of Maryland

Colony production records were secured from single brood chamber migratory hives in a year when practically no nectar was gathered from the tuliptree. Failure of yield from the tuliptree is extraordinary; records show this to be the only failure in 30 years. Heavy bloom on black locust accompanied by seven consecutive superior flight days and heavy bloom of clovers (white Dutch and sweet) set up compensating nectar flows east of Hancock and resulted in the following colony yields:

Emmitsburg	70 lbs.
Boonsboro	87 lbs.
Hancock	34 lbs.
Poolesville	70 lbs.

In late July a part of the Poolesville and Emmitsburg apiaries were moved to the Lower Eastern Shore to test the long lima bean flow and to secure data on migrating. This apiary yielded a 40 pound average from bean, whereas check colonies at Poolesville and Emmitsburg yielded no surplus during this period.

Winter losses for 1951-52 were as follows:

Hancock	20%
Poolesville	16.6%
Emmitsburg	13.6%
Lower Eastern Shore	None

A two brood chamber apiary was established at Boonsboro for experimental work in 1952. (*Project H-53*)

Third Brood European Corn Borer Assumes Greater Importance

Studies on the biology of the European corn borer under insectary conditions have indicated that, for the most part, there were two generations in Maryland. On occasion there have been indications that there was a partial third brood. Field studies during the summer indicated that the percentage of borers with three generations is far greater than formerly anticipated.

Normally early emerging corn borer moths do not have suitable corn available upon which to lay eggs, therefore they resort to potatoes or other plants for egg deposition. Field studies in Cecil County showed that second-generation moths were emerging abundantly from potatoes by July 7th. These moths were caged over sweet corn and by mid-July eggs for a third brood were being laid in abundance. Caged corn stalks were cut on August 20 and showed that approximately 20 per cent of the larvae present had already pupated. The pupae from these second generation borers began emerging on August 21, and by August 26 eggs from second brood moths were being deposited in cages. First hatching of third brood eggs was observed on August 29. (*Project H-43*)

Parasites of European Corn Borer Established in State

Efforts to establish two species of parasites on European corn borer have been successful. The fly, *Lydella stabulans grisescens* R.D., appears well adapted to Maryland conditions and is generally present through the state in sufficient numbers to be of value. In the fall surveys of 1950 parasitism of hibernating larvae for the state as a whole was 35 per cent, and highest local infestation was 60 per cent in the lower Eastern Shore.

The average parasitism by Lydella in 1951 was less than the previous year while *Macrocentrus gifuensis* Ashm., a wasp parasite of the larvae increased from a trace in 1950 to 10 to 25 per cent in 1951. *Macrocentrus* is well established in central and western Maryland, where it has exceeded *Lydella* in some localities. Efforts will be made this year to establish new *Macrocentrus* colonies of this parasite in parts of the State where it does not now occur. (*Project H-43*)

Tests Reveal Best Nozzles, Times of Spraying for Corn Borer

In experiments on control of European corn borer and earworm on late season sweet corn, neither solid nor hollow cone nozzles gave better results than the now recommended flat spray type. There was no significant difference in results where two and four nozzles per row were used. There will be no change in nozzle recommendation as a result of this work.

An extensive experiment was carried out to determine the best time of applying sprays for combination earworm and corn borer control. Where one application of spray was applied best results were secured when 75 per cent or more of silks were showing. When two sprays were applied with the first when 20 to 30 per cent of silks were showing, a second treatment four or five days later gave best results rather than the formerly recommended three day period between application. On heavily infested very late corn more than two sprays may be required to give control if the corn is grown for the green market. (*Project H-43*)

Horticulture

The research in horticulture is being carried on with studies of production and cultural problems of fruit, vegetable, floricultural, and ornamental crops. Technological and food quality studies in the processing of vegetables and fruits are also important. This work is being done in several areas of the state, with the Plant Research Farm, greenhouses, and laboratories of the Experiment Station at College Park serving as the center of operation.

The most important recent addition to the Department of Horticulture's facilities for research is the new range of greenhouses completed and placed in use in the spring of 1952. These new greenhouses will permit an expansion of research with floricultural and nursery crops as well as with fruits and vegetables where the controlled conditions of a greenhouse are needed. Such greenhouse studies are invaluable in solving certain physiological problems of plant growth. In breeding programs for new and better varieties, the greenhouse makes possible several years' results in one by providing year-round growing conditions.

Many of the studies in horticulture are being conducted in the fields, orchards, and processing plants of growers and canners. Their cooperation is making available facilities and conditions for research which cannot be obtained at the Experiment Station. Such cooperation is always deeply appreciated by research workers.

Brief summaries of the more important findings in recent horticultural research are presented in the following pages. Detailed information on the projects is available in scientific journal papers, station bulletins, and popular articles released by the Experiment Station.

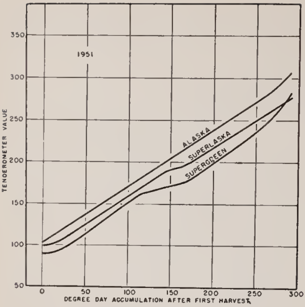
Vegetables

Vegetable Variety Trials for Maryland Adaptability Continue

The continuous introduction of new varieties of vegetables makes it important to repeat variety tests year after year, in order that local adaptation may be determined.

Peas: Alaska, Superlaska, and Supergreen peas were harvested on nine successive dates in 1951. Supergreen exhibited a marked delay in maturation during the harvesting period, and Superlaska showed a slight retardation in maturity, as compared to Alaska. The delay appears to result from a rather abrupt delay in toughening rather than a generally slower development. These characteristics of the Superlaska and Supergreen varieties provide a longer harvesting season for peas—a factor of great practical importance to the processor of this crop. Tenderometer values correlated closely with the alcohol insoluble solids values determined.

Broccoli: Sixteen varieties of broccoli were tested at the Vegetable



Rate of maturation of Alaska type peas in relation to temperature summation. Note the abrupt delay in maturation of the Supergreen variety after the peas reached a tenderometer reading of 160.

Research Farm near Salisbury. Killing temperatures in late November reduced the yield of the later types. This being the first year for studies with this crop, the tests are being repeated in 1952. Production of broccoli for freezing is increasing rapidly in the lower Eastern Shore area.

SWEET POTATOES: Twenty-nine varieties and strains of sweet potatoes were tested at Salisbury, continuing the search for new types suitable to Maryland conditions. Maryland Golden was equal or superior to all other varieties in total yield and production of market size roots. Yellow Jersey, Big Stem Jersey, Rols, Orlis, Jersey Orange, and Orange Little Stem all produce higher yields of canning grade roots than Maryland Golden, but were lower in total production.

TOMATOES: Of eighteen varieties and lines tested, only Urbana, STEP 57, and Selection No. 2 from the Campbell Soup Company were superior in yield of marketable tomatoes to Rutgers. Urbana was relatively free of cracking, although the tomatoes were smaller than Rutgers. (*Project Q-74*)

Promising Results in Sweet Potato Cracking Control Studies

Research on cracking of the sweet potato, a trouble which at times has caused severe losses to Maryland growers, has been directed toward two objectives: first, to determine the underlying factors responsible for cracking; and second, to develop a practical method for controlling cracking in the field.

The first objective was attacked by a critical comparative study of the growth, development, internal structure, and physiological behavior of two varieties, Maryland Golden which is particularly susceptible to cracking, and Jersey Orange, a variety which normally shows little cracking, were studied. These studies have shown that the larger roots of Maryland Golden result from a higher growth rate toward the end of the growing season.

Microscopic examination of the expanding tissues has shown that roots of the Jersey Orange variety have a more uniform cellular structure (pericyclic parenchyma), a wider cambial ring, more active secondary cam-

A promising new sweet potato selection of the "yam" type developed by the Station, is adapted to Maryland conditions.

bium, and smaller but more numerous xylem vessels than Maryland Golden. In microenvironmental tests involving variations in temperature and humidity, it was found that the tissues of the Jersey Orange roots were much more active than Maryland Golden.

Cracking may be defined as a rupture of the outer tissues because they fail to keep pace with the rapidly expanding central portion of the root. In the Maryland Golden variety, the low activity of tissues and cambium, the non-uniform pericyclic parenchyma, the high water affinity of the storage roots together with the low water affinity of the vines, and the high rate of growth at the end of the season, may be listed as contributing to cracking.

Research in developing control measures for cracking has centered on the effects of soil moisture, fertilization, soil fumigation, and growth regulators. Although drastic changes in soil moisture conditions will affect the amount of cracking, it was also found that maintenance of optimum soil moisture by irrigation did not prevent cracking. Similarly, no positive direct association of fertilizer practices with cracking has been found.

Treatment of the soil with the soil fumigant DD (dichloropropanedichloropropene mixture) before planting has definitely reduced the amount of cracking in several trials. The most promising treatment thus far tested has been the application of foliar sprays of the growth regulator NAA (naphthalene acetic acid). In 1951 this chemical was very effective in reducing the amount of cracking in the Maryland Golden variety. Further expanded trials are underway in 1952 to test the material under commercial conditions. (*Project L-74-a*)

Cantaloupes Receiving Foliar Nutrient Sprays Show Increased Sugar Content

Holding the foliage of cantaloupe plants has long been recognized as a necessary requirement for high quality melons. Loss of foliage has rather consistently been attributed to infection with downy mildew. Recent findings show that a part of the defoliation may be due to a deficiency of magnesium.

Magnesium deficiency in this crop so closely resembles downy mildew that it is difficult to distinguish between the two disorders by ordinary examination. Three years of testing at Salisbury have shown that spray applications of zineb plus 4 pounds magnesium sulfate (Epsom salts) and 2 pounds borax per 100 gallons decreased the defoliation and increased the percentage of soluble solids of the fruits in 2 years out of 3. This combination was found to be the only effective one out of 22 nutrient combinations tested. The tests have also shown that zineb is more effec-

TABLE 3—Effect of Nutrients Sprays on the Per Cent Soluble Solids in Cantaloupes

TREATMENT	AVERAGE % SOLUBLE SOLIDS			Average
	1949	1950	1951	
Zineb only (check)	8.77	8.17	6.54	7.83
Zineb plus magnesium sulfate plus borax	10.09	8.33	7.09	8.50
Zineb plus ferrous sulfate	9.35	8.26	7.02	8.21
L.S.D. @ 5%	....	....	....	0.43

tive than nabam as a fungicide in the combination. (*Project Q-79-c*)

Supplemental Irrigation Affects Mineral Uptake of Sweet Potatoes

Supplemental irrigation is being used increasingly by vegetable growers in Maryland. During the past two years a study has been made of the effect of irrigation on the utilization of mineral elements by the sweet potato. Increased yields were obtained on the irrigated plots in both years, but particularly in the drier year of 1950 and on plots receiving high nitrogen fertilization.

Analyses of leaves, vines, and storage roots showed that irrigation had a decided effect on the concentration of certain mineral elements in the plant tissues. Leaves and vines from the irrigated plots had lower concentrations of calcium and magnesium and higher concentrations of phosphorus and potassium than those from the unirrigated plots. The composition of the roots was not affected markedly by irrigation.

The irrigated plants utilized more nitrogen, phosphorus, potassium, and calcium. However, the total uptake of magnesium was less despite the increased yield of the irrigated plants. It is believed that the effect of irrigation on the concentration and uptake of magnesium and calcium may have a significant bearing on the response of the irrigated plants to fertilizer applications. (*Project Q-79-F*)

New Methods in Vegetable Crop Management are Tested

Production methods and techniques in handling vegetable crops are changing more rapidly now than ever before in the history of the industry. Increasing mechanization in planting, spraying, weed control and harvesting to offset advancing labor costs is presenting problems in production which must be answered.

Calcium cyanamide has proven effective in weed control in spinach, as shown in the comparison between the treated area (left) and untreated spinach.

Plant spacing of tomatoes: A two year study reveals no differences in yields of tomato plants spaced 3½x 3½, 4x4, 3½x5, and 5x3½ feet. These tests were conducted on a silt loam soil, the crop was sprayed for disease control, and 2000 pounds of fertilizer was plowed down.

The wider plant spacings make possible more efficient spraying and cultivation without reduction of yields, as well as requiring fewer plants per acre.

Weed control in peas and spinach: Dow Selective Weed Killer applied at the rate of 3 pints in 100 gallons of water per acre, and calcium cyanamide at the rate of 275 pounds per acre increased the yield of peas and reduced the weed population. Calcium cyanamide decreased the rate of maturation of the crop.

Application of calcium cyanamide to spinach at the rate of 400 pounds per acre 4 days before seeding reduced the weed population and increased the yield. Only slight injury was observed from the treatment.

Frequency to harvest cucumber pickles depends upon price: Frequency of harvest studies on pickles revealed that at a high contract price the grower realized the greatest net return from 2-day intervals between pickings. At a medium contract price, the return was greatest with a 2-day interval when picking labor was obtained at 50c per hour, but when labor cost 75c per hour, the return was highest at a 4-day interval. With a low contract price the net return was greatest at a 4-day harvesting interval. (*Project Q-77*)

Fertilizer Application Studied in Relation to Chemical Composition and Storage Behavior of Sweet Potatoes

The effects on sweet potatoes of soil applications of muriate of potash, Epsom salts and borax were studied. The influence of the fertilizer combinations on respiration rate, nitrogen, mineral and carbohydrate constituents, and storage behavior was determined.

Dry matter, alcohol insoluble solids, starch, and sucrose in sweet potatoes both before and after storage were found to be in inverse relation to the soil level of muriate of potash during the growing season. Fertilizer containing 6 per cent potash produced sweet potatoes which respired at a greater rate during curing than any of the other combinations. Potassium content of the roots was higher, and magnesium content was lower when the muriate of potash level was increased.

Boron content of the roots increased with addition of borax to the soil only when potash was at the 18 per cent level. The least weight loss in storage was found in those roots fertilized with 183 pounds of muriate of potash and 4.5 pounds of borax per acre. (*Project Q-77 and Q-79-F*)

Fruits

Chemical Thinning of Apples Shows Great Promise

Removal of excess fruits in order to gain acceptable market size and improved quality has long been a standard commercial practice in fruit growing. However, less hand thinning of heavily loaded apple trees is being practiced in Maryland due to the prohibitive cost. An acute need exists for some relatively inexpensive method of thinning, and chemical sprays give promise of fulfilling this need.

Studies in commercial Maryland orchards in 1952 indicate that sprays

Young apple orchard at Plant Research farm for comparative study of red-color sports of important varieties.

of naphthaleneacetic acid (NAA) will thin York Imperial and Stayman apples which have set too heavily. Experiments on timing of the spray showed that applications can be made too early and too late. Generally, NAA sprays applied immediately after bloom failed to thin enough, while those NAA treatments applied three weeks after bloom or later overthinned the trees. Rates of concentration must be varied dependent upon the inherent ability to set a heavy crop of fruit of each variety but generally falls between 10 and 20 parts per million.

Tree vigor was found to be the greatest single factor governing success with chemical thinning sprays. With reasonably good vigor, response to the thinning spray was excellent, while overthinning resulted on all trees which were low in vigor. It is evident, however, that bee activity in bloom, weather conditions during the bloom period, proximity of pollinating varieties, etc., should all be considered in the use of chemical thinning sprays.

Further studies are needed to develop a general chemical thinning schedule which can be recommended to the apple industry. However, the experimental results have been so promising that Maryland growers are being urged to try specific NAA treatment on limited numbers of trees.

Trials to date have shown that NAA sprays are erratic and unreliable on peaches. Although peaches can be chemically thinned with the dinitro compounds applied in full-bloom, this treatment is impractical for Maryland orchards since the danger from subsequent frosts is too great. Hence work was started in 1952 to screen a number of organic growth regulating compounds in an attempt to find one which would be effective in post bloom thinning. (*Project L-74*)

Mulching Increases Growth of Young Peach Trees

Mulching peach trees during the first and second season after planting has resulted in greatly increased growth during that period in an ex-

Experimental block of peach trees receiving different soil and cultural treatments.

perimental orchard block at the Plant Research Farm. The trials also have shown that trees mulched with a high-nitrogen content material such as pea vines are larger and darker green than those receiving a low-nitrogen mulch such as wheat straw. The latter mulch however, showed a decided improvement in growth over the non-mulched trees. Leaf analyses are underway to determine the effect of mulching upon mineral nutrient uptake by the trees. (*Project L-74*)

Raspberry Selections from Breeding Program Show Unusual Promise for Maryland

During the year, marked progress was made on research which was started a few years ago to develop commercial raspberry varieties which would be expecially adapted to Maryland soil and climate. Greater resistance to frequent injury from Maryland's "open-type" winters, better disease resistance, and adaptability to high summer temperatures are required for more successful commercial production.

Several thousand plants set two years ago from a wide variety of red-fruiting crosses have yielded some very promising selections. Plants from a newer series of crosses set to the field in substantial numbers last year fruited for the first time and produced some highly promising material. One series of crosses combining European, American, and Asiatic species of red raspberries produced plants having the excellent size and color of the European type with the exceptional disease and heat resistance of the Asiatic form. From selections of these as well as others, it appears entirely possible to develop new varieties meeting the requirements for Maryland's own conditions.

Work more recently started to provide better adapted black-cap varieties was continued and expanded. The excellent progress in a relatively short period indicates that improved black varieties for Maryland will be soon forthcoming. (*Project L-73*)

Adaptability Studies Continued on New Fruit Varieties for Maryland Conditions

A favorable season made possible an excellent evaluation of all of the more recently introduced peach and apple varieties and selections originating from this or other stations. Records on quality, yield, size, color, firmness, etc., were obtained on more than 50 peach varieties and this information is now available to commercial growers for guidance when making new plantings. While many of these cannot be recommended in place of existing proved varieties, the information obtained from these screening-out tests is of utmost value to orchardists by preventing loss of time and money in the planting of varieties unsuited to Maryland climate and soils.

Most of the newer apple varieties under test have not as yet come into full production. It will be several years before a complete evaluation of performance can be made.

Newly named introductions of both apples and peaches were added to the test plantings so that reliable information will be available for future plantings. (*Project L-75*)

A field of young red raspberry plants from various crosses to provide better adapted future varieties for Marylands conditions.

Processing

Maryland Apples Make Excellent Juice Concentrate

Earlier research was devoted to the development of a satisfactory method of preparing an apple juice concentrate using a low temperature-vacuum process. The work continued during the past year to determine the relative suitability of the varieties grown in Maryland for concentrate preparation, using Rome, York, Delicious, Ben Davis, Stayman, and Winesap. Concentrates of one-fourth and of one-sixth the original juice volume were prepared several times during the storage season, and held at zero and 35 degree temperatures.

Taste panel ratings of the juices after reconstitution to original volume showed Stayman, Winesap, and York to have the highest flavor ratings. The degree of concentration, temperature of storage and time of preparation of the concentrate during the apple storage season had no observable effect on the flavor ratings.

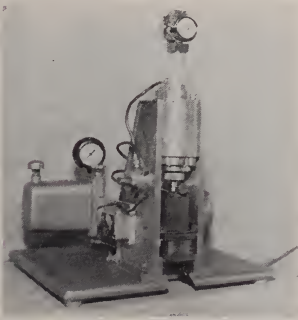
Color of the concentrates varied both with the variety and with the time at which the juices were prepared during the season. Rome, Stayman, York, and Winesap produced the lightest colored, clearest juices. Ben Davis and Delicious concentrates were dark and turbid. With all varieties the concentrates held at 35 degrees were lighter colored upon reconstitution than those held at zero.

The excellent quality of the juice from concentrates of Stayman, York, and Winesap makes this method of processing a promising additional market outlet for these varieties. (*Project L-58-G*)

New Model Shear-Press Undergoing Final Tests

The shear-press, a general purpose instrument for accurately measuring hardness, toughness and fibrousness of vegetables, has been in the process of development at the Station for the past several years. On the basis of data obtained during the past year, a new model (K3) has been constructed featuring a highly accurate strain gauge, and a metering device for the precise control of the speed of stroke.

The new model proved to be entirely satisfactory, so that six additional instruments were constructed and are under experimental use at six different research institutions. The results from these test instruments will be collected and analyzed to determine the need for possible additional modifications. The shear-press will then be released for general manufacture for use by the food industry as standard equipment for research and quality control. (*Project Q-58-F*)



The modified Maryland Shear-Press a multiple-purpose instrument developed for measuring hardness and toughness qualities of vegetables is now undergoing final tests under commercial conditions.

Improved Method of Grading Lima Beans for Processing Developed

There is general agreement among processors and growers that methods now used in the grading of lima beans are unsatisfactory. Work undertaken in cooperation with a number of processing firms, growers, and the U.S. D.A., reveals the outlines of a new comprehensive method that promises to be accurate and objective, and therefore fair to all parties concerned.

The new method is based on a unique sampling procedure. This consists of obtaining the sample for grading at a specific point on the viner, since it has been discovered that a sample obtained exactly midway between the second and third opening of the full viner corresponds to the average quality in the lot. Four tests are made separately, and combined into a single grade: (1) maturity or hardness is measured by the shear-press; (2) trash dockage is measured by a specially constructed miniature screen; (3) the per cent of whites is measured visually but is subject to confirmation by a photo colorimetric test; and (4) culls are noted visually. (*Project Q-58-F*)

How Many Times Should Snap Beans be Harvested?

Labor supply and quality of product are two major problems confronting the growers and processors of snap beans.

The labor problem is particularly severe in connection with harvesting. The development of a mechanical bean picker has advanced sufficiently to indicate eventual success in solving this problem. However, with the advent of a mechanical bean picker, fields may be picked only once; whereas they are usually hand-picked twice and occasionally even three or four times. Thus, the grower must decide whether it is worthwhile to use a mechanical harvester and harvest once only, at some loss in potential yield; or continue with expensive, hard-to-get labor with a higher yield and perhaps higher quality.

The answers to some of these questions may be found in the results obtained in a recently completed three-year study on snap beans. It was found that when the first harvest is delayed until the beans mature to the point where they will be of only standard quality, very little is to be gained from a second harvest. Under such conditions machine harvesting would be unquestionably advisable. However, if the first harvest is to be made at a sufficiently early stage of maturity so that the quality will remain in the fancy stage, a second harvest may yield from 40 to more than 100 per cent additional beans. The quality necessary or desired thus becomes an important feature in determining the applicability of mechanical harvesting. In general, the round varieties (Stringless Green Pod, Tendermost, Topcrop, etc.) show lower yields on the second harvest, and the flat beans such as Black Valentine have greater second harvest yields. (*Project Q-58-F*)

Floriculture And Ornamentals

Dual Purpose Plants for the Homeowner being Tested

Home owners in Maryland are always interested in planting trees, shrubs, and vines which in addition to being ornamental are of some value in bearing edible fruit. Many who have tried the standard commercial varieties of tree and bush fruits have been disappointed because the plant selected was not satisfactory from a landscape point of view. Others have been subject to attack of insects and diseases to the extent that the fruit was unsatisfactory or took too long to attain bearing size.

A planting of over 65 varieties of fruiting plants is being established at the Plant Research Farm to test the desirability of many types of plants for both ornamental value and fruiting characteristics. Plants to be recommended must be ornamental in appearance and bear fruits or nuts which are desirable. The additional characteristics of hardiness, ease of culture, and relative freedom from insects and diseases are being kept in mind before recommendations will be made for home planting. Although it is too early to give positive results of trials, the preliminary observations indicate that certain crabapples, blueberries, elderberries, gooseberries, juneberries, and a wide variety of dwarf cherries, most nearly meet these requirements. (*Project L-75*)

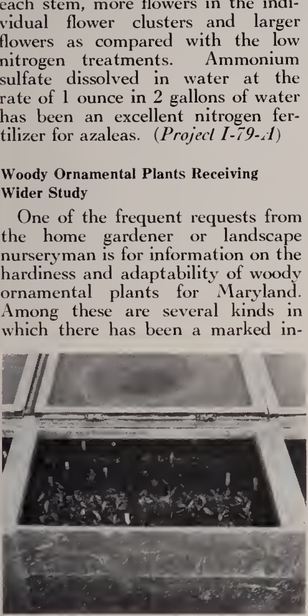
Fertilization of Azaleas Results in More Flowers

Work with azaleas both for outdoor ornamental planting and for greenhouse forcing has been continued. A light soil mixed with one-third peat or a heavier soil mixed with both sand and peat have proven to be very satisfactory for their growth. When azaleas are grown in such a soil mixture, the fertilizer requirements are principally nitrogen. Even when grown in pure quartz sand, the greatest growth response was from the high levels of nitrogen regardless of the levels of phosphorus and potash.

Experiments in the greenhouse showed that a high nitrogen level not only resulted in greater growth but in better flowering as well. Larger amounts of nitrogen resulted in the formation of more flower buds on each stem, more flowers in the individual flower clusters and larger flowers as compared with the low nitrogen treatments. Ammonium sulfate dissolved in water at the rate of 1 ounce in 2 gallons of water has been an excellent nitrogen fertilizer for azaleas. (*Project I-79-A*)

Woody Ornamental Plants Receiving Wider Study

One of the frequent requests from the home gardener or landscape nurseryman is for information on the hardiness and adaptability of woody ornamental plants for Maryland. Among these are several kinds in which there has been a marked increase in interest and use during recent years, notably hollies, azaleas and camellias. New experimental plantings have been established of these kinds of plants, as well as others to determine the best varieties for general use or for various specialized uses. Plants of recognized satisfactory varieties have been planted together with newer or less well known kinds. Records of rate and habit of growth, flowering, and winter hardiness will be made. These plantings are being extended with newer varieties so that rather complete information will be available. From this study will come new suggestions of kinds of woody ornamental plants that may be recommended for landscape use. (*Project I-74-A*)



Improved methods of rooting cuttings of azaleas are being sought. With the use of certain root-inducing substances, together with carefully controlled temperatures and periods of light, 100 per cent rooting is now possible.

Poinsettia Flowering Affected by Fertility

It has been a common practice for florists forcing poinsettias for Christmas sales to maintain a low fertility level during the late summer and early fall so that the plants do not grow too tall. Experiments at this station have shown that this practice may seriously delay the flowering of the plants. This problem was studied further as poinsettias were known to form flowers in response to a short

Research studies indicate that fertilizer treatments previous to bloom, markedly affect flowering time of poinsettias. Plants above are part of an experiment to gain new information for florist use.

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The Plant Research Farm located six miles north of the University is a center of field plot work in horticulture and agronomy.

length of day. The stem tips of plants growing under different experimental treatments of fertility and day length were examined under the microscope at various times during the growth of the plant.

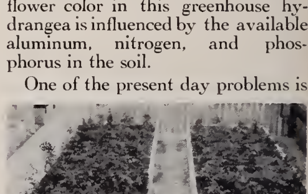
When the plants were suddenly subjected to very short days the stem tip changed to a flowering condition within 5 to 6 days. The flower development, however, was greatly retarded under the low fertility treatments. The plants under the normal fall conditions of gradually shortening lengths of day were delayed almost 2 weeks in changing to a flowering condition by the low fertility treatment. The high fertility plants began to form flower buds on October 6 while the low fertility plants did not show beginning flower bud formation until approximately October 19. (*Project I-74-A*)

Hydrangea Breeding

There is a continuing demand for the improvement of plants for florists' use and a program of improving the greenhouse hydrangea (*Hydrangea macrophylla*) for this purpose has been started. A number of varieties for greenhouse forcing are now on the market, but a majority of them are of European origin.

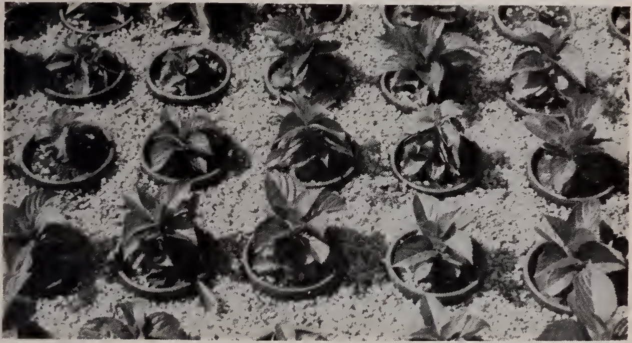
An ideal variety for forcing purposes should be one which develops rapidly, is easily propagated and has moderate sized dark green foliage. The flower color should be clear and intense. This latter characteristic is especially important since the flower color in this greenhouse hydrangea is influenced by the available aluminum, nitrogen, and phosphorus in the soil.

One of the present day problems is



The new chemical soil conditioners hold great potential value for use in greenhouse culture. Each of the plots in the above beds have been planted in soil receiving different amounts and types of such soil conditioner to study the growth and flowering response of roses.

the production of varieties of good clear and intense blue or pink color. Manipulation of the soil conditions is sometimes only partially successful. This breeding program is aimed at producing new varieties in which the color may easily be controlled together with the other desirable growth characteristics as well as ease in forcing. Several selections from crosses already made show interesting possibilities. (*Project 1-74-A*)



A group of hydrangea seedlings from crosses aimed to secure superior new varieties for greenhouse forcing. Note the variation in leaf size and vigor, important characteristics which must be considered in the selection of any new variety.

Poultry

Feeding

Unidentified Growth Factors Receiving Further Study

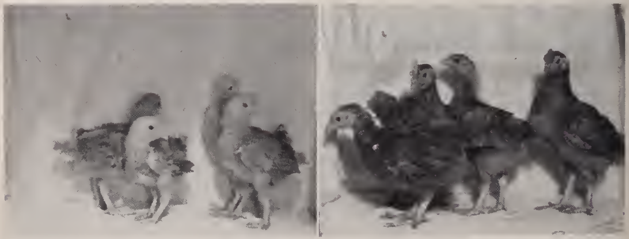
Studies have been continued which confirm the existence of two different unidentified factors required for rapid growth of chicks. Both practical-type and purified-type rations have been used. One of these factors can be supplied by either fish meal, liver products, or dried brewers' yeast while the other is present in dried whey products and fermentation solubles. A potent concentrate of the first of these factors has been prepared from liver by chemical and physical fractionation. This concentrate was effective in promoting the growth of chicks when fed at a level of 22 milligrams per pound of diet.

It has also been found that the requirement of the chick for the factor present in liver is increased when the hormone, thyroxine (supplied by iodinated casein), is fed. The bacterial flora which becomes established in the chick during the first few weeks of life also appears to exert an influence on the requirement for these factors. (*Project M-35-g*)

Other research has been carried out on a factor found in hydrolyzed soybean meal which is needed for growth of the bacterium (*Microbacterium flavum*). The isolation of this factor also is being studied. A complex peptide which increased the growth of another organism (*Lactobacillus lactis*) has been partially purified and studied as to its chemical composition. (*Project M-35-k*)

Findings Reveal Protein Level of Broiler Rations Can be Lowered after Six Weeks of Age

Experiments with large numbers of broilers show that the total protein level in all-mash broiler rations may be reduced from 21 per cent to 18 per cent at 6 weeks without impairing the growth rate. Such a reduction of the protein level in rations for broilers 6 weeks of age and older should improve



The 4-week-old New Hampshire chicks on the left received a purified diet deficient in a growth factor still to be identified. Those on the right were fed the same diet plus a liver supplement apparently containing this important unknown factor.

This battery brooder is used for nutrition studies at the Poultry Department. These facilities permit the study of specific variables under controlled conditions. Sixteen such batteries are in use.

feed efficiency as well as lowering feed costs.

The use of different all-mash rations to reduce the protein level is believed to be more desirable than the feeding of supplemental scratch grains or low-protein pellets. Less feather pulling and better market quality of birds should result on the all-mash system. The protein level may be reduced by replacing a portion of the soybean oil meal in the all-mash starting ration with an equal amount of corn. Tests now in progress, indicate that the reduction of the protein level to 17 per cent at 7 weeks of age may be the most practical program to follow.

Experiments have also been carried out to determine the value of supplemental DL-methionine in broiler rations. In one trial, the addition of 1 pound of methionine was found to improve the average weight at 10 weeks by almost 0.2 pound. At the same time, the feed required to produce each pound of broiler was reduced by 0.12 pound. (*Project M-35-i*)

Protein levels and methionine supplementation are being studied at the Poultry Farm. This floor pen is typical of the 26 broiler units.

Ration Can Improve Feathering and Feed Efficiency of Broilers

In a trial conducted at the Salisbury Poultry Experimental Farm, the addition of nicotinic acid and calcium pantothenate to a practical-type broiler ration improved the feathering condition, growth rate, and feed efficiency of broilers housed in pens with radiant-heated floors. Under these conditions, the addition of 20 grams of niacin per ton of feed resulted in better feathering, heavier birds, and slightly better feed conversion than was obtained when 0 or 10 grams of niacin were added per ton. Including 5 per cent wheat standard middlings, 5 per cent pulverized oats, or a combination of both also slightly improved the feather scores at 10 weeks. Nevertheless, the addition of these materials does not appear to be an economic way to counteracting poor feathering, since they reduced feed efficiency.

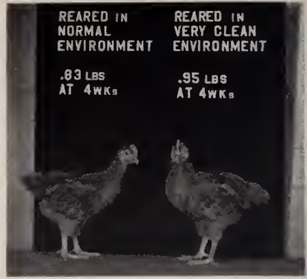
The most striking observation in this trial was the marked improvement in the feathering condition between the broilers housed in the floor pens heated with overhead hot water heat and containing litter as compared with those broilers reared in pens heated with radiant heat and containing no litter. All groups housed in the pens with litter and overhead heat showed excellent feathering and derived no additional benefit from the supplements. (*Project M-35-l*)

Chicks Reared in Clean Environment Show Little Antibiotic Response

Since bacterial contamination of the environment was considered likely to influence the action of antibiotics in stimulating growth in chicks, a study was carried out to compare results in a very clean and a normal environment. Chicks reared in a new room containing new equipment (very clean environment) grew more rapidly than chicks reared under the usual environment (normal) for battery brooder-reared chicks. This was true regardless of the type of ration used. The addition of penicillin did not appreciably improve the growth of chicks reared in the very clean environment, while a growth response was observed in the normal environment.

A compilation of results of several experiments with chicks reared in battery brooders under normal conditions and fed various practical-type rations revealed that the average improvement in gain during the first 4, 6, and 8 weeks of life was 17.2 per cent, 12 per cent, and 6.4 per cent, respectively, when penicillin was added to the ration. A level of from 2 to 2½ grams per ton is considered satisfactory for use in chick-starting rations or broiler mashes since in these trials, levels from 1 to 2½ grams per ton stimulated growth to approximately the same extent as higher levels.

In one battery trial, two surface acting agents (surfactants) were used at levels of 50 and 100 milligrams per pound. No growth responses were noted as a result of the addition of these surfactants to the feed until the birds were 5 weeks of age. However, by the end of the 7th and 8th weeks, the combination of the two surfactants used had stimulated growth of the chicks to the same degree as was obtained with penicillin. Combinations of the surfactants and penicillin were no more effective than either supplement alone. (*Project M-55-1*)



These chicks are representative of large numbers of chicks reared in a normal (left) vs. a very clean environment (right). The very clean environment consisted of new equipment in a new room never before used for poultry. The normal environment refers to that of the University of Maryland poultry nutrition laboratory. Chicks from one source were fed identical rations with appreciable differences in average weights.

Results of research suggest that chick growth is affected by the number and types of bacteria in the intestinal tract. Here, a research worker counts the numbers of various types of bacteria plated from ceca of chicks. At the right are two jars which permit the incubation of cultures under anaerobic conditions.

Effect of Antibiotics and Bacterial Flora on Chick Growth Studied

The bacteria in the intestinal tract appear to have a decided influence on the growth of chicks or other animals. Previous work in this department has shown that antibiotics increase the number of coliform bacteria and reduce the numbers of lactobacilli in the chick cecum. Accordingly, chicks were fed massive cultures of these coliform bacteria (*Aerobacter aerogenes* and *Escherichia coli*) to determine their influence on growth. Slight but consistent increases in growth over controls were noted when these cultures were fed. These results suggest that chick growth is influenced by the types and numbers of microorganisms present in the intestinal tract of the chick. (*Project H-55-k*)

Breeding

Strain Comparisons being Made for Broiler Production

Since feed costs approximate 70-75 per cent of the total cost of broiler production, the amount of feed needed per pound of poultry meat produced (feed efficiency) is very important. The young growing chicken uses approximately 60 per cent of its feed for body maintenance and only 40 per cent for growth. Feed efficiency is thus highly affected by rate of growth. There is some evidence that there are genetic differences among strains or breeds which affect feed efficiency independent of growth rate. To secure maximum profits, then, the broiler producer must have birds that not only grow relatively rapidly but also make efficient use of their feed. Research is therefore underway to compare established strains of breeds of broiler chickens with regard to rate of growth, feed efficiency, feathering, mortality, and market quality.

A trial was conducted at the Salisbury Experimental Farm in which 8,000 birds, comprising two 500-bird pens of each of 8 different breeds or strains, were grown under practical commercial conditions. Data were collected on growth rate, feed conversion, mortality, and feathering of the breeds and strains under test. The results indicate that there are important breed and strain differences in relation to rate of growth and feed efficiency. Differences among strains within a breed proved to be more important than differences among breeds. The results also showed that there may be strain differences in feed efficiency which are not entirely explained by differences in rate of growth.

At 10 weeks of age mortality amounted to only 4.15 per cent, a re-

Breeds and strains of broilers show differences in rate of growth and feed efficiency. Among those compared in Maryland tests were Indian River Cross, New Hampshire Red, and White Plymouth Rock.

latively low figure, and the average weight of all the birds of the different strains was approximately 3.0 pounds. The entire group averaged approximately 2.9 pounds of feed per pound of gain in weight, feed conversion being quite efficient.

The most rapid-growing strains of White Plymouth Rocks weighed 3.0 pounds and used 2.74 pounds of feed for each pound of gain. The most efficient crossbreds, secured from a mating of Barred Plymouth Rock males and New Hampshire females, weighed 3.1 pounds and consumed 2.87 pounds of feed for each pound of gain in weight. The most efficient strain of New Hampshires weighed 3.1 pounds and used 2.9 pounds of feed per pound of gain. (*Project M-33-k*)

New Medium Sized Strain of Turkeys being Developed to Combine Rapid Early Growth with High Egg Production

The development of the Beltsville White strain of turkeys has served to emphasize the fact that domesticated turkeys can be bred to reproduce more efficiently. The Beltsville White hen lays considerably more eggs with a higher degree of fertility than almost any other variety. On the other hand, the Broad Breasted Bronze turkey is known to be one of the most efficient birds in the conversion of feed to human food. The Bronze turkey unfortunately does not lay as well as the Beltsville White and a rather large percentage of the eggs are infertile. A combination of very rapid early growth and an efficient rate of reproduction seems a logical goal to strive toward in turkey breeding.

Research toward this goal is underway. During the current year, fifteen single-tom matings were made using six to eight females per male. This breeding stock was selected from pedigreed progeny produced in the spring of 1951. The breeders were selected on the basis of conformation, color, and growth rate from among the progeny of dams that has exhibited high egg production, fertility, and hatchability. From these matings approximately 1,000 poults have been pedigree-hatched and reared to four weeks of age under uniform battery conditions. Selection in

The eight-week-old poults (left) are of a new medium-sized strain of turkeys being developed at the Maryland Experiment Station. Future breeding stock is selected for growth and fleshing (right).

Over 150 broiler producers attended a field day at the University of Maryland poultry experimental farm near Salisbury to learn first-hand the results of the third broiler test on breed and strain differences in growth and efficiency of feed conversion.

the current year will be on a family basis and will be based upon the reproductive ability of the parents and the growth rate exhibited by the poults. Because white feathered turkeys are generally easier to prepare for market and because they are desired in the rapidly developing turkey broiler industry, this new breed of turkey is being gradually changed to carry the white plumage. Since the white color is of a genetically recessive nature and easy to establish, more emphasis is being placed upon growth and reproduction leaving the purification of color for later development. (*Project M-34-e*)

General

What is the Effect of Hormone Treatments on Breeding Ability and Egg Production?

The endocrine system of the body produces many different hormones which in turn exert a marked influence on body processes. Within recent years commercial preparations of these hormones, or materials having hormone-like activity, have become available. The work under this project has been designed to determine the feasibility of using some of the readily available hormones to alter certain physiological processes in the bird. The female sex hormone has been used quite extensively in depressing the male sex hormone production and thus increasing the market quality of broilers. The depressing of the male sex hormone production likewise renders the males much less active and decreases the damage from fighting among the birds. Since some of the broilers so treated are occasionally held for breeding stock, the effect of the

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treatment upon subsequent reproductive performance was investigated. It was found that implanting 8-week old growing birds with diethylstilbestrol pellets materially reduced their subsequent reproductive ability. Hens so treated laid fewer eggs and they were smaller in size and had thinner shells than did the eggs of untreated birds. Males so treated produced noticeably less semen. It would thus appear that this treatment should not be employed upon birds intended to be maintained for egg production or as breeders. (*Project M-33-h*)

Factors Discovered which Affect Thickness of Egg Shells

Thin-shelled eggs are a serious problem to the commercial poultryman, particularly during the hot summer months, and represent an economic loss. As a result studies were conducted to screen a number of hormones that might influence egg shell quality. Thyroxin, the hormone produced by the thyroid gland, tended to increase the thickness of the shells, while thiouracil, a compound which inhibits the natural production of thyroxin, decreased shell thickness. Progesterone, a hormone produced by the ovaries, likewise decreased shell thickness.

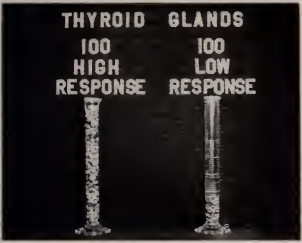
Previous reports have shown that the antibiotic penicillin affects the metabolism of calcium. This material was investigated and was found to have a marked effect on shell quality. When procaine penicillin was added to the ration of laying hens at the rate of 15 or 30 grams per ton, shell quality was definitely improved. (*Project M-33-h*)

Thyroid Activity of Poultry May Cause Difference in Growth, Feed Utilization, and Feathering

It has long been recognized that there are marked differences among the breeds and strains of domestic poultry with respect to their growth rate, rate of feathering, egg production and other traits of economic importance. These traits are under genetic control and can be influenced by selective breeding. The gene or genes involved must affect some physiological mechanism to bring about the desired results. Too little is known concerning the mechanism influenced by the gene or genes to make selection of maximum value. The activity of the thyroid gland has also been shown to be under genetic control. It would appear then, that some of the differences among breeds and strains can be explained on the basis of differences in thyroidal activity.

Experiments are being conducted to determine the role of the thyroid gland and other associated endocrine glands in bringing about differences in the economic qualities of different strains. Strains of birds have been developed which differ markedly in their thyroidal activities. These birds have been selected on the basis of the response of their thyroid glands when fed a compound to inhibit thyroxin production. Those with the greatest response to this compound normally have the lowest thyroxin production while those with low-response have high thyroidal activity.

Preliminary data indicate that the low-response line is superior in egg production and hatchability while the chickens from the high-response line tend to grow more rapidly. During the course of the spring brooding season, a severe outbreak of Newcastle disease was experienced. The mortality among the birds of the low-response line (high thyroidal activity) was only one-third as much as among the birds with the high-response line, indicating that thyroidal activity may also be related to disease resistance. (*Project M-33-k*)



Studies indicate that thyroid activity of chickens may affect egg production, growth and disease resistance. Left, thyroid glands from 100 high-response birds. Right, glands from 100 low-response birds.

Infertility of Semen Studied in Chickens and Turkeys

The large amount of infertility present in hatching eggs of both chickens and turkeys and the tremendous loss associated with this infertility has focused research attention upon the physiological processes concerned with fertility. One approach is to study the factors effecting fertility from the standpoint of the male sex cells, the spermatozoa. While artificial insemination is not widely practiced at present in the poultry field, it does offer possibilities when more is known concerning the handling and preserving of semen.

Studies have been conducted to determine the effects of adding antibiotics and the sex hormones to semen being preserved for artificial insemination. It has been found that terramycin added to whole semen will increase the survival time of the cells and this survival time should be associated with higher fertility. When the sex hormones are added to an oil and the oil used as a protective layer over the surface of the semen, survival time is also increased. The combining of these two treatments has an additive effect.

Further investigations have been carried out studying the effect of low temperature on sperm survival. Even when semen has been lowered to the temperature of dry ice motile cells were found upon thawing. Techniques are being studied to secure fertile eggs from hens inseminated with semen so treated. When semen is stored at this low temperature (-110°F), it retains its motility for indefinite periods of time but fertility has been lost. If techniques can be developed which will allow storage at this temperature without seriously impairing fertility it will obviously enhance breeding programs. (*Project M-33-j*)

Rural Sociology

Reading Habits of Farm People Studied

Success or failure at farming depends more and more upon the farmer's ability to read and understand technical writing and upon his ability to develop social and economic perspective. Thus, educators, Extension workers, and librarians need to know the emphasis rural people put on reading if they are to serve them well.

Studies of rural reading habits were continued in Prince George's County with the cooperation of the U. S. Department of Agriculture, the Prince George's County Library and volunteer workers interested in better library service for their communities.

Among the findings are these: (1) Pleasure is the strongest reading motive among the rural population as a whole, but farm people read more for information than do non-farm men and women. (2) Farm people borrow books from the public library twice as often as from any other source. (3) One-fifth of the farm people interviewed said they would like to be able to borrow phonograph records from the library. (4) Most rural men read the newspaper more than any other type of publication. Rural women ranked books and magazines as being of almost equal interest. (5) The level of living is 20 per cent higher among those who read agricultural bulletins than among those who do not. This level is based on several factors: the education of the head of the family; home ownership; whether the home has electricity, running water, and a telephone; and whether the family owns an automobile, a radio and a phonograph. Rural white males are the principal readers of agricultural bulletins. *(Project S-1)*

Soil Conservation Research

Report on cooperative projects between the U. S. Department of Agriculture Soil Conservation Service, Division of Research, and the Maryland Agricultural Experiment Station, College Park, Maryland, for the year ending June 30, 1952.

Ridge Row Culture Studied Further

Ridge row culture is being developed as a means for reducing and controlling destructive effects of high intensity summer rainfall on land being cropped to tobacco in Southern Maryland. The crop is grown on strongly ridged rows laid out on a slight continuous grade. The ridges prevent crosswash erosion and gullying while the channels between rows drain off the surplus water and prevent drowning.

Results of three season's studies comparing ridge row culture with standard tobacco cultivation show an average advantage of $61 per acre per year in favor of ridge row culture. The ridging with controlled row grades has been particularly beneficial in a season with unusually heavy rainfall during the early part of the growing season and it has not reduced yields in dryer seasons.

In these studies heavy cover crop mixtures of wheat and vetch have been late-turned each year to provide a heavy organic residue. In other studies, excellent tobacco crops have been grown on ridged rows following sod crops in rotations.

Removing excess water from tobacco fields requires a network of terraces and grassed waterways in addition to ridged rows. Waterways must be relatively wide and have sufficient capacity for peak flow. Ridge row culture was tested by five cooperating farmers in Southern Maryland Soil Conservation Districts during the past season. The ridges gave excellent erosion control during several flash rains.

Winter Cover Crops Increase Tobacco Yield and Quality

In continued studies of winter cover crops, both kind of cover and date of turning have been found important to the yield and quality of the tobacco crop. The early turning date has been about April 15 while the late turning has been one month later. The dry top growth of a wheat and vetch mixture turned early has averaged about 1,000 pounds while the late-turned wheat-vetch has averaged almost four times this amount. This delayed turning has greatly increased the coarse organic matter in all cases.

In these studies early plowing of ryegrass alone has increased the value of tobacco produced $59 per acre compared with no cover crop. Turning the ryegrass one month later has reduced the value by $26 compared with no cover crop.

Hairy Vetch alone has greatly increased the crop yield, particularly when turned late, but the crop quality with this late turned legume has been very poor. When vetch is grown in mixtures with the non-legumes wheat, rye or ryegrass, the high yielding influence of the legume is maintained and the tobacco quality is

This six acre field of tobacco growing on Collington sandy loam (left) has been severely damaged by erosion though the field has gentle slopes. Compare this with the field shown at right. This wide grassed waterway is doing an excellent job on a farm near Mitchellville, Maryland.

improved. Early plowing of the mixtures has given a total increase of $231 per acre compared with no cover and the tobacco quality was increased 3.5 cents per pound.

Delayed turning of these same mixtures further increased the tobacco yield and quality giving an additional $106 per acre. The late turning of the mixtures gave a yield of 1,548 pounds per acre compared with 1,342 pounds for the early turning.

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443. Your Tobacco Experimental Farm. (Prepared by staff members of the Agronomy Department) 10 pp. April, 1952.

A63. Prepackaging Spinach and Kale. F. Pope, Jr., G. M. Beal and R. L. Harrison. 18 pp. August, 1951.

A64. Market Area for Delmarva Broilers. H. D. Smith. 16 pp. August, 1951.

A65. Quality Changes in Shell Eggs in Carlot Shipments and in Storage. J. M. Gwin. 31 pp. June, 1952.

A66. Studies on the Nutrition of Lactobacillus Lactis, the Organism Used for the Isolation of Vitamin B_{12}. Mary S. Shorb and G. M. Briggs. 12 pp. June, 1952.

A67. Research Leads the Way to Agricultural Progress . . . 64th Annual Report. Year ending June 30, 1951. I. C. Haut. 88 pp.

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A69. Rural Reading Habits. P. M. Hauser, R. E. Galloway and H. Hoffsommer. 31 pp. June, 1952.

A70. Relation of Various Egg Marketing Methods to Producer Returns in Maryland. H. Smith and John Trower. 29 pp. June, 1952.

A71. Studies or the European Corn Borer, Corn Ear Worm and Fall Army Worm on Sweet Corn. E. N. Cory, L. P. Ditman and G. W. Lloyd. 20 pp. June, 1952.

A72. Parasites of the European Corn Borer in Maryland. E. N. Cory, H. S. McConnell, K. D. Arbuthnot and D. W. Jones. 13 pp. June, 1952.

A73. Variety, Description and Performance Tests with Maryland Tobacco Measured by Composition, Yield and Value. J. D. Bowling, J. E. McMurtrey, Jr., and D. E. Brown. 21 pp. June, 1952.

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X5. Consumer Preference and Buying Habits for Chicken. H. D. Smith. 23 pp. September, 1951.

X6. Retail Merchandising and Consumer Acceptance of Eggs and Poultry. H. D. Smith and H. H. Hoecker. 29 pp. September, 1951.

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113. Comparative Census of Maryland Agriculture by Counties. A. B. Hamilton. (*Lithographed Circular*). 52 pp. August, 1951.

133. Property Tax Problems in Rural-Urban Fringe Areas. F. E. Hulse and W. P. Walker. (*Multigraphed Circular*). 24 pp. May, 1952.

140. A Survey of Broiler Houses and Equipment. H. D. Smith. (*Mimeographed Circular*). 14 pp. June, 1952.

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Department of Poultry Husbandry

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Current Projects

(*These are projects and not publications available to the public*)

Agricultural Economics and Marketing

Project No.	
A-18-ac	Farming Alternatives in Major Competing Potato Areas. R. W. Hoecker, G. M. Beal and J. M. Curtis.
A-18-ae	Organization and Operation of Representative Types of Farms in Maryland. A. B. Hamilton.
A-18-af	An Economic Study of Dairy Farms in Maryland. A. B. Hamilton and A. L. Lundquist.
A-18-ag	Agricultural Productive Capacity and Efficiency. P. E. Nystrom and A. B. Hamilton.
A-18-ah	A Study of Broiler Housing and Facilities in Relation to Production Efficiency and Methods of Financing. H. D. Smith.
A-19-i	Improving Farm Building Assessments for Tax Purposes. S. H. DeVault , W. P. Walker, L. B. Bohanan, W. T. Sigafoose, F. E. Hulse.
A-19-j	Sales Taxes and Their Application to Farmers. S. H. DeVault, W. P. Walker and F. E. Hulse.
A-19-k	Recent Tax Changes in Maryland and Their Effect on Farmers Tax Obligations. S. H. DeVault, W. P. Walker, P. R. Poffenberger, W. T. Sigafoose and F. E. Hulse.
A-19-1	Financial Status and Security of Farmers. P. R. Poffenberger, W. P. Walker, S. H. DeVault, W. T. Sigafoose.
A-19-m	Rural Cooperative Credit. P. R. Poffenberger, W. P. Walker and R. W. Roberson.
A-19-n	Economic and Security Aspects of Rural Fire Protection and Prevention in Maryland. S. H. DeVault, W. P. Walker, D. J. Burns and F. E. Hulse.
A-19-o	Conservation and Economy in Rural Transportation of Persons, Supplies and Farm Commodities. S. H. DeVault, W. P. Walker and L. C. Biser.
A-26-l	Prices Paid by Farmers for Commodities Bought. P. R. Poffenberger.
A-26-q	Marketing Premium Sweet Corn Direct from Grower to Retailer. D. B. Diamond, and G. M. Beal.
A-26-s-2	Improving the Marketing of Maryland Cantaloupes. G. M. Beal and M. R. Larsen.
A-26-s-3	The Marketing of Maryland Wheat. G. M. Beal.
A-26-w	Increased Consumption of, and Lower Marketing Costs for Apples and Peaches Through Adoption of Better Distribution Practices. G. A. Stevens and G. M. Beal.
A-26-aa	Relation of Various Egg Marketing Methods to Producer Returns in Maryland. H. D. Smith.
A-26-ab	The Marketing and Distribution of Maryland Canned Vegetables. R. L. Childress.
A-26-ac	Reducing Costs, Determining and Maintaining Quality, Increasing Efficiency in Marketing Maryland Poultry Products. H. D. Smith, and Francis Dallavalle.
A-26-ad	Possible Economies in the Marketing and Transportation of Poultry Meat. H. D. Smith.
A-26-ae	Lowering Marketing Costs: Increasing Efficiency in the Operation of Milk Receiving Processing and Distribution Facilities. G. M. Beal and C. R. Twining.

A-26-af Sub. 1	Collection of Basic Data on Marketing Shenandoah-Cumberland Apples. R. L. Childress.
A-26-af Sub. 2	Processors as a Market Outlet for Cumberland-Shenandoah Apples. R. L. Childress.
A-26-eg	Marketing of Maryland Type 32 Tobacco. G. M. Beal, Paul Summers and S. C. Shull.
A-32-f	Farm Tenancy and Leasing Arrangements in Maryland. L. B. Bohanan, S. H. DeVault and A. B. Hamilton.
A-32-h	The Effect of Drainage Upon Crop Yields, Farming Practices and Land Utilization. S. H. DeVault and L. B. Bohanan.
A-32-i	Rural Zoning in Maryland. L. B. Bohanan.

Agricultural Education

Project No.	
T-1	Possibilities of Education with Adult Farmers. R. A. Murray and A. M. Ahalt.

Agricultural Engineering

Project No.	
R-11-c	Mechanization of Tobacco Production. R. W. Carpenter, G. J. Burkhardt, A. V. Krewatch, P. N. Winn, Jr., E. W. Martin, O. E. Street, Claude McKee.
R-11-d	Tobacco Housing. R. W. Carpenter, G. J. Burkhardt, A. V. Krewatch, P. N. Winn, Jr., E. W. Martin, O. E. Street and Claude McKee.
R-11-e	Structures and Equipment for Tobacco Stripping. R. W. Carpenter, G. J. Burkhardt, A. V. Krewatch, P. N. Winn, Jr., E. W. Martin, O. E. Street, and Claude McKee.
R-12	Drying Ear Corn with Natural Air in Maryland. G. J. Burkhardt, H. H. Hoffmeister, P. N. Winn, Jr., and R. G. Rothgeb.
R-13	Development of Equipment for Field Application of Insecticides to Canning Corn for Control of the European Corn Borer. G. J. Burkhardt, E. W. Martin, H. J. Hoffmeister and L. P. Ditman.
R-14	Mow Curing Hay in Maryland. H. J. Hoffmeister, A. V. Krewatch, E. W. Martin.
R-15	Development of Equipment and Improved Method for Harvesting Canning Tomatoes and Bush Beans. H. J. Hoffmeister, Jr., E. W. Martin and E. P. Walls.

Agronomy

Project No.	
B-39	Varietal Improvement of Wheat. R. G. Rothgeb and J. L. Newcomer.
B-41	Barley—Variety Testing. R. G. Rothgeb.
B-43	Soybean Production in Maryland. R. G. Rothgeb.
B-44	Sweet Corn Improvement. R. G. Rothgeb.
B-50	Improvement of Dent Corn. R. G. Rothgeb and A. O. Kuhn.
B-56-a	Improvement of Red Clover Adapted to Maryland. C. H. Liden and T. S. Ronningen.
B-56-b	Pasture Renovation Studies. A. W. Burger, T. S. Ronningen and A. O. Kuhn.
B-56-d	Alfalfa Strain and Variety Evaluation. T. S. Ronningen.
B-56-e	Red Clover Strain and Vareity Evaluation. C. H. Liden and T. S. Ronningen.
B-56-f	The Evaluation of Forage Crop Varieties and Strains for their Use and Adaptation in Maryland. T. S. Ronningen, A. W. Burger and A. O. Kuhn.
B-56-g	Development and Maintenance of Superior Ladino Clover Breeding Material. T. S. Ronningen.
B-56-i	Orchard Grass Breeding. T. S. Ronningen and A. W. Burger.
B-56-j	Grass and Legume Combinations for Beef Production. A. W. Burger, E. C. Spurrier, T. S. Ronningen, A. O. Kuhn and J. E. Foster.

B-56-k	Phenological Studies in Forages. T. S. Ronningen, A. M. Decker, H. C. S. Thom and A. W. Burger.
B-57	The Improvement, Production and Use of Rye in Maryland. R. G. Rothgeb.
B-58-a	Control of Weeds in Corn by the Use of 2, 4-D, Preparations. C. H. Liden.
B-58-b	Control of Weeds in Legumes. A. O. Kuhn, L. F. Morris, T. L. Bissell.
B-59	Improvement in Plant Bed Management for Maryland Tobacco. O. E. Street, O. D. Morgan, Jr., W. B. Posey, E. E. Clayton, J. E. McMurtrey, Jr.
B-60	Tobacco Fertilizer Rates and Placement in Relation to Plant Population. C. G. McKee, O. E. Street, J. E. McMurtrey, Jr.
B-61	Effects of Cropping Systems on Soil Properties and Productivity. E. Strickling, R. G. Rothgeb and A. O. Kuhn.
B-62	Spacing Test with Maryland Tobacco. W. B. Posey and O. E. Street.
B-64	Testing Commercially Acceptable Maryland Tobacco Varieties as Related to Quality. L. R. DeLoach and O. E. Street.
O-28-b	A Study of the Formula and Analysis for Late Potatoes. J. H. Axley and H. B. Winant.
O-43	Hydrologic Studies with Reference to Soil Moisture Conservation, Soil Fertility and Flood Control. R. G. Rothgeb, C. P. Ellington and H. W. Hobbs.
O-45-b	A Study of the Availability of Phosphate Material. J. H. Axley, H. B. Winant and A. H. A. El-Damaty.
O-47-b	A Study of Neutralization Value of Slag for Maryland Soils. J. H. Axley and F. L. Bentz.
O-48	A Study of the Reclassification of Soils and the Adaptation of These Classes to Soil Conservation Work in Maryland. J. H. Axley, A. O. Kuhn, S. P. Stabler and F. L. Bentz.
O-50	Moisture Studies. J. H. Axley. H. B. Winant and A. O. Kuhn.
O-51	Alfalfa Fertility Studies. J. H. Axley, H. B. Winant, J. R. Miller and A. O. Kuhn.

Agronomy—Seed Inspection

Project No.	
N-7	Inspection of Seeds Sold Throughout the State.
N-8	Examination of Samples from Seeds Sold Throughout the State.
N-9	Examination of Samples Submitted to the Laboratory. F. S. Holmes, O. M. Kelk, A. H. Ferguson, E. P. Emack and R. W. Caldwell.

Animal Husbandry

Project No.	
C-8	Swine Breeding Investigations Within the State of Maryland. W. W. Green M. H. Kerr, and J. E. Foster.
C-14	A Study of the Productiveness of Purebred Beef Cattle in Maryland. W. W Green, J. E. Foster, and J. Buric.
C-14-a	Effect of Early Weaning on the Duration of Maternal Influences in Beef Calves W. W. Green, J. Buric and J. E. Foster.
C-14-b	Type Classification as an Aid in Selection of Beef Breeding Cattle. W. W Green, J. E. Foster, J. Buric, M. E. Gannon and J. M. Vial.
C-14-c	Studies on Bodily Conformation and the Correlations Between Live-Animals Measurements and the Weight and Other Characteristics of Carcasses of Wholesale Cuts in Beef Animals. W. W. Green, F. E. White and G. L. Jessup, Jr.
C-18	A Study of the Causes and Prevention of Bloat in Beef Cattle on Pasture. J. E. Foster, W. W. Green, S. P. Stabler and R. V. Pratt.
C-20	The Development of Superior Lines of Swine Based on Crossbred or Purebred Foundations. W. W. Green, M. H. Kerr, J. E. Foster and J. C. Siegrist.

Animal Pathology

Project No.	
D-46	Bang's Disease—Calfhood Vaccination. Cornelia Cotton and Patricia Fell.
D-50	Anaplasmosis of Cattle. L. J. Poelma and Kenneth Price.
D-51	Experiments with Infectious Enterohepatitis (Blackhead) of Turkeys. H. M. DeVolt.
D-52	Newcastle Disease Investigations with Particular Reference to Vaccine Modifications and Virus Study. R. L. Reagan, Dorothy M. Schenck, W. C. Day and Marilyn P. Harmon.
D-53	Role of Disturbances in the Acid-Base Balance in the Parturient Cow and their Significance in the Cause of Milk Fever and Ketosis. (Acetonemia) R. B. Johnson.
D-54	A Study of the Infectious Bovine Mastitis; Its Control and Eradication and the Economic Losses Attending. P. C. Brown, E. M. Sacchi and H. G. Lineweaver.

Botany

Project No.	
F-9	Cytogenetic Studies in the Genera Ipomoea, Gladiolus and Tulipa. D. T. Morgan, Jr., R. D. Rappleye and E. T. Brown, Jr.
F-12	The Native Plants of Maryland, Their Occurrence, Distribution and Economic Importance. R. G. Brown.
F-15-a	Heterosis in Hybrids from Homozygous Lines Obtained from Haploid Plants. D. T. Morgan, Jr., R. D. Rappleye and D. F. Wetherell.
J-78-a	Breeding Strawberries for Resistance to the Red Stele Disease Caused by *Phytophthora fragariae* Hickman. W. T. Jeffers, D. H. Scott and J. G. Kantzes.
J-86-a	Methods of Controlling Diseases Affecting Commercial Production of Sweet Potatoes in Maryland. W. F. Jeffers, C. E. Cox, J. E. Moore, J. G. Kantzes and graduate assistants.
J-87	Treatments for Control of Seed and Soil Borne Disease of Vegetable Crops. C. E. Cox and graduate assistants.
J-88	Development of Identification and Control Procedures for Plant Virus Diseases in Maryland. W. F. Jeffers, C. E. Cox, L. O. Weaver, O. D. Morgan, O. E. Street, E. E. Clayton, E. G. Beinhart and assistants.
J-89	Development of Improved Strains of Maryland Tobacco Resistant to Diseases. O. D. Morgan, O. E. Street, E. E. Clayton and assistants.
J-90	Adaptability of Disease Resistant Varieties of Potatoes to Maryland. C. E. Cox, R. A. Jehle and J. E. Moore.
K-7	Physiological and Biochemical Aspects of Vegetable Storage. H. G. Gauch and W. M. Dugger, Jr.
K-8-a	Relationship of Boron to the Flowering and Fruiting of Plants. H. G. Gauch and W. M. Dugger, Jr.
K-8-b	A Determination of the Concentrations of Various Inorganic and Organic Components Coincident with Maximal Yields of Certain Crop Plants in Maryland. H. G. Gauch and W. M. Dugger, Jr.

Dairy Husbandry

Project No.	
G-27-a	The Effect of Certain Feed Stuffs Upon the Vitamin A Requirements of Dairy Cattle. J. C. Shaw and M. F. Ellmore.
G-34	Chemical Changes in Milk Fat as Related to the Flavor of the Milk. Mark Keeney.
G-35	The Analysis of Dairy Products. Mark Keeney, E. A. Corbin and T. A. Fitzpatrick.
G-37	The Feeding and Management of the Cow During the Dry and Freshening Period. J. C. Shaw, J. W. Pou, Janet Gilbert, B. C. Hatziolus and W. M. Gill.

G-38	The Fat Metabolism of the Mammary Gland. J. C. Shaw, J. W. Pou, R. E. Brown and A. C. Chung.
G-39	Factors that Affect the Availability of Nutrients in Feeds and Their Influence Upon Blood Composition and Milk Secretion. J. C. Shaw, H. M. Irvin, J. W. Pou and E. C. Leffel.
G-40	The Influence of High Temperature Heat Treatments on Certain Physical and Chemical Properties of Milk. Mark Keeney and T. A. Fitzpatrick.
G-42	Methods of Processing and Other Factors Affecting the Quality of Ice Cream. W. S. Arbuckle and J. W. Nisonger.
G-43	The Metabolism of Acetate, B-hydroxybutyric Acid, Glucose and Other Carbon Compounds in Lactating Ruminants. J. C. Shaw, S. Lakshmanan, S. Kumar and A. C. Chung.

Entomology

Project No.	
H-29-6	Investigations of the Biology and Control of Insects Affecting Canning Crops. *Sub. 6.* The Pea Aphid. Insecticidal Control and Timing Treatments. L. P. Ditman and E. N. Cory.
H-29-g	Investigations on the Biology & Control of Insects Affecting Canning Crops. Insecticidal Control of the Mexican Bean Beetle. L. P. Ditman and W. E. Bickley.
H-35	Nursery Insects. E. N. Cory and G. S. Langford.
H-40	Biology and Control of Tobacco Insects. *Sub. 1.* The Tobacco Horn Worms. H. S. McConnell.
H-43	The Biology and Control of the European Corn Borer Under Maryland Conditions. E. N. Cory, L. P. Ditman, H. S. McConnell and G. Burkhardt.
H-46-a	Concentrated Sprays. The Development of Liquefied Gas Insecticide Aerosols and Machinery for their Application. L. P. Ditman, G. J. Burkhardt and H. B. Owens.
H-46-b	Concentrated Sprays. Combined Insecticidal and Fungicidal Aerosols. L. P. Ditman and C. E. Cox.
H-48	The Codling Moth. C. Graham.
H-50	The Biology and Control of the Pests of Commercial Floriculture.
H-51	The Effect of DDT on Aquatic Life. E. N. Cory.
H-52	The Effect of Various Formulations of DDT on Plant and Animal Development. E. N. Cory and E. E. Haviland.
H-53	Nectar Resources of Maryland. G. J. Abrams.
H-55-a	The Control of Insects Attacking Peach Foliage and Fruit. C. Graham.
H-56	Patuxent Project on the Effect of Soil Conservation Upon Insect Populations. H. B. Owens, E. N. Cory and L. P. Ditman.
H-57	Relation of Insect Injury to Yellowing and Decline of Alfalfa. T. L. Bissell and S. P. Stabler.

Horticulture

Project No.	
I-26-a	Rooting of Ornamental Plants Difficult to Propagate. P. W. Cornell, J. B. Shanks, B. Bridgers and W. Preston.
I-58-a	A Physiological Study of the Keeping Qualities of Cut Flowers as Influenced by Packaging. J. B. Shanks and C. B. Link.
I-74-a	Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Hydrangeas and Azaleas. C. B. Link, J. B. Shanks and P. W. Cornell.
I-79-a	The Mineral Nutrient Requirement of the Azalea. C. B. Link and J. B. Shanks.
I-79-b	The Mineral Nutrition of the Hydrangea. J. B. Shanks and C. B. Link.
L-58-g	Determination of Varietal Adaptability of Maryland Grown Apples to Making of Canned and Frozen Concentrates and Development of Improved Methods of Preparation. J. S. Caldwell, E. P. Walls, Albert Kareskevitch and E. Phillips.

L-73	Adaptation of Fruit Varieties and New Seedlings to Maryland. I. C. Haut, A. A. Piringer and F. J. Lawrence.
L-74	Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson, F. J. Lawrence and I. C. Haut
L-74-a	Relation of Environmental and Soil Factors to the Cracking of Sweet Potatoes. L. E. Scott, F. C. Stark, W. A. Matthews, A. A. El-Kattan, W. L. Ogle and A. A. Duncan.
L-79-a	Mineral Nutrition of the Strawberry with Particular Reference to Effects of Calcium, Potassium and Magnesium on Growth and Fruiting. I. C. Haut, L. E. Scott and A. A. Piringer.
Q-58-f	Develop Objective and Easily Applied Measures of Quality Factors Involved in Market Grades and Standards. A. Kramer, I. C. Haut, L. E. Scott, H. S. Todd, K. Aamlid, C. L. Dame and E. D. Giggard.
Q-58-h	Development of Methods of Preparation of Canned and Frozen Tomato Concentrates. E. P. Walls, J. S. Caldwell and L. E. Scott.
Q-67-a	The Influence of Organic Residues in the Production of Asparagus. F. C. Stark.
Q-74	A Study of Regional Adaptation on Certain Vegetable Crops and Varieties in Maryland. F. C. Stark, E. P. Walls and W. A. Matthews.
Q-77	Crop Management Studies with Vegetable Crops. F. C. Stark, E. K. Bender, A. Kramer and L. E. Scott.
Q-79-b	The Mineral Levels and Interrelationships of Mineral Nutrients in Fruit Plantings of Maryland. L. E. Scott, I. C. Haut and C. O. Dunbar.
Q-79-c	Influence of Nutrient Intensity and Balance on the Quality and Physiological Defoliation of Cantaloupes. F. C. Stark, W. A. Matthews and S. H. Todd.
Q-79-e	Influence of Nutrient Intensity and Balance Upon the Yield and Quality of Tomatoes. F. C. Stark, A. Kramer, W. A. Matthews, L. E. Scott and S. H. Todd.
Q-79-f	Mineral Nutrition of the Sweet Potato with Special Reference to Cation Interrelationships. L. E. Scott, F. C. Stark, A. A. Duncan, W. L. Ogle and W. A. Matthews.
Q-81	Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. C. Stark.
Q-82	Tomato Breeding and Selection with Particular Reference to Greater Resistance to Cracking and to Late Blight. F. C. Stark.

Poultry Husbandry

Project No.	
M-32-k	Difference in Thyroid Activity as Related to Strain Differences in Growth, Feed Utilization and Feathering. C. S. Shaffner and W. E. Shaklee.
M-33-h	Hormonal Control of Economic Traits in Poultry. C. S. Shaffner, H. Garren, A. Gabuten and A. C. Akpinar.
M-33-i	Development of a Flightless Strain of New Hampshire Chickens. C. S. Shaffner and M. A. Jull.
M-33-j	Semen Studies with Chickens and Turkeys. C. S. Shaffner, Philip Bogdanoff and S. H. Qureshi.
M-33-k	Strain Comparisons for Broiler Production. C. S. Shaffner and M. A. Jull.
M-34-e	Medium Sized Strain of Turkeys with Certain Desirable Qualities. C. S. Shaffner and M. A. Jull.
M-35-g	The Requirement of the Growing Chick for Newer Members of the Vitamin B Complex. G. H. Arscott, H. L. Jones, H. Menge, Peng-Tung Hsu and G. F. Combs.
M-35-i	Amino Acids in Poultry Nutrition. G. F. Combs, Peng-Tung Hsu and P. F. Twining.

M-35-k	Unidentified Growth Factors for Chickens and Bacteria. M. S. Shorb, G. F. Combs, K. Kao, G. L. Romoser, William Scott, R. McCarthy and R. Bishop.
M-35-l	Development of Improved Rations and Feeding Methods for Broiler Production. G. F. Combs, Henry Jones and P. F. Twining.
M-45	New Studies on the Causative Effects of Wheat in Pullet Disease. G. D. Quigley and H. M. DeVolt.

Sociology

Project No.	
S-1	Community and Population Bases in Planning County Library Services. H. H. Hoffsommer, R. E. Galloway and Paul Houser.

Changes in Personnel

Appointments

Marie M. Bestul, M.A., Instructor, Sociology, September 1, 1951.

D. J. Burns, M.S., Instructor, Agricultural Economics, August 15, 1951.

I. C. Haut, Ph.D., Director of Experiment Station, July 1, 1951.

F. E. Hulse, M.S., Research Assistant, Agricultural Economics, September 1, 1951.

R. W. Krauss, Ph.D., Research Associate, Botany, July 1, 1951.

P. E. Nystrom, D.P.A., Professor and Head, Agricultural Economics, July 1, 1951.

A. H. Thompson, Ph.D., Professor, Horticulture, March 1, 1952.

Resignations

S. H. DeVault, Ph.D., Professor and Head, Agricultural Economics, July 31, 1951.

R. A. Jehle, Ph.D., Professor, Botany, February 1, 1952.

M. R. Larsen, M.S., Assistant Professor, Agricultural Economics, June 30, 1951.

J. E. Moore, B.S., Instructor, Botany, November 30, 1951.

W. T. Sigafoose, B.S., Research Assistant, September 15, 1951.

S. C. Shull, M.S., Associate Professor, Agricultural Economics, February 9, 1952.

Station Staff

I. C. Haut, *Director*

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P. E. Nystrom, D.P.A., Prof. and Head of Dept.
G. M. Beal, Ph.D., Professor, Agr. Econ.
L. B. Bohanan, M.S., Asst. Prof. Agr. Econ.
D. J. Burns, M.S., Instr. Agr. Econ.
A. B. Hamilton, M.S., Assoc. Prof. Agr. Econ.
F. E. Hulse, M.S., Res. Asst.
P. R. Poffenberger, M.S., Assoc. Prof. Agr. Econ.
H. D. Smith, M.S., Asst. Prof. Agr. Econ.
W. P. Walker, M.S., Prof. Agr. Econ.

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W. W. Green, Ph.D., Prof. Animal Husbandry
M. H. Kerr, M.S., Assoc. Prof. Animal Husbandry
J. B. Outhouse, M.S., Assoc. Prof. Animal Husb.

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Cornelia M. Cotton, Ph.D., Coop. Agent
H. M. DeVolt, M.S., D.V.M., Prof. Path.
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L. O. Weaver, Ph.D., Prof. Botany and State Plt. Path.

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J. S. Conrad, B.S., Asst. Insp. Dairy Husb.
Edgar Corbin, M.S., Instr. Dairy Husb.
M. F. Ellmore, B.S., Instr. Dairy Husb.
Mark Keeney, Ph.D., Asst. Prof. Dairy Mfg.
E. C. Leffel, M.S., Instr.
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Elizabeth Haviland, Ph.D., Asst. Prof.
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P. W. Cornell, M.S., Assoc. Prof. Flor.
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C. B. Link, Ph.D., Prof. Flor.
W. A. Matthews, M.S., Assoc. Prof.
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J. B. Shanks, Ph.D., Assoc. Prof. Physiol.
F. C. Stark, Ph.D., Prof. Veg. Crops
A. H. Thompson, Ph.D., Prof. Pomology
S. H. Todd, B.S., Instr. Hort.
E. P. Walls, Ph.D., Prof. Canning Crops

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G. F. Combs, Ph.D., Prof. Poult. Nutrition
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C. S. Shaffner, Ph.D., Prof. Poult. Husb.
Mary Shorb, Ph.D., Prof.

SEED INSPECTION

F. S. Holmes, M.S., Chief Seed Inspector

SOCIOLOGY

Marie M. Bestul, M.A., Instr.

Financial Statement – July 1, 1951 to June 30, 1952

FEDERAL FUNDS

					Research Marketing			
	Hatch	Adams	Purnell	Bankhead-Jones	9b-1-9b-2	9b3	Title II	
Appropriation 1951-52	$ 1.26 $14,998.74	$15,000.00	$60,000.00	$36,488.62	$ 6,224.29 $46,606.00	$ 1,067.56 $18,718.02	$1,095.38 $6,500.00	
TOTALS	$15,000.00	$15,000.00	$60,000.00	$36,488.62	$52,830.29	$19,785.58	$7,595.38	
Receipts from sources other than Federal 1951-52								**For Agr. Investigations***
State Appropriations for Agricultural Investigations								$330,932.27
Industrial Grants								73,548.17
Sales and Miscellaneous								130,885.93
								$535,276.37
Balance brought forward July 1, 1951								104,984.92
TOTAL								$640,261.29
Expenditures:								
Personal Services	$ 6,650.00	$11,800.00	$49,225.46	$26,244.94	$35,740.50	$ 8,299.79	$3,363.23	$303,278.53
Travel	4,344.46	124.15	385.45	3.35	270.12	1,733.00	229.35	13,098.96
Transportation		1.56	5.09	51.70	20.40	16.62		548.76
Communication Service		7.66	71.72	41.13	24.14	22.66	44.89	1,712.72
Rents and Utility Services			61.10	16.17	106.45	118.66		2,014.03
Printing and Reproduction	1,570.32		3.25	18.48	1,371.23	735.23	838.50	3,590.67
Other Contractual Services		378.97	927.68	990.08	1,278.04	858.13	557.92	27,950.03
Supplies and Materials	1,742.50	1,913.31	6,878.80	6,622.69	7,846.47	5,199.64	102.95	137,729.73
Equipment	692.72	448.50	2,219.27	2,500.08	5,518.78	2,427.06	50.32	43,760.93
Lands and Structures		325.85	222.18		654.16	15.60		8,190.47
Contributions to Retirement								
	$15,000.00	$15,000.00	$60,000.00	$36,488.62	$52,830.29	$19,426.39	$5,187.16	$541,874.83
Balance June 30, 1952						359.19	2,408.22	98,386.46
TOTALS	$15,000.00	$15,000.00	$60,000.00	$36,488.62	$52,830.29	$19,785.58	$7,595.38	$640,261.29

* Including Bankhead-Jones Offset Funds.

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Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Agricultural Experiment Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge to all residents of the State who request them.

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